THE PLAGUE AND QUARANTINE.

REMARKS

ON SOME

EPIDEMIC AND ENDEMIC DISEASES;

(INCLUDING THE PLAGUE OF THE LEVANT,)

AND THE

MEANS OF DISINFECTION:

WITH A DESCRIPTION OF

THE PRESERVATIVE PHIAL.

ALSO A

POSTSCRIPT ON DR. BOWRING'S PAMPHLET.

"The pestilence that walketh in darkness, and the destruction that wasteth at noon-day."

"—— vitiatas inficit auras."

SECOND EDITION.

BY JOHN MURRAY, F.S.A., F.L.S.,
&c., &c.

LONDON:
RELFE AND FLETCHER, CORNHILL.
1839.

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THE CHAIRMAN AND MEMBERS OF THE CHAMBERS OF COMMERCE,
OF MANCHESTER AND OF LIVERPOOL.

GENTLEMEN,

I venture, with much deference and respect, to submit the following pages to your candid consideration. I have no other object in view but the public good.—"May commerce flourish," but let not her standard be planted on the GRAVE.

Dr. Bowring's Pamphlet seems to me calculated to lead to erroneous impressions, because a 'one-sided' and partial, and I will add, an UNFAIR statement has been made. As his lucubrations have been fearlessly canvassed in this Pamphlet, (though I have not so limited its usefulness,) and as the question of Quarantine Laws is to commerce, one paramountly important, I have endeavoured to embody within a very restricted compass, the real aspect of the case, not doubting that your intelligence and enlightened judgment will discern rightly.

I have the honor to be,
Gentlemen,
Your very humble Servant,
THE AUTHOR.

Hull, 20th June, 1839.

CRITICAL NOTICES

ON THE FIRST EDITION OF THE WORK.

"It will be read with interest, and followed by conviction. We recommend the pamphlet to every scientific and philanthropic reader, as offering a method by which his own health may be preserved, and the well being of the community at large materially promoted."—*Bath Post*, 14th July, 1838.

"The author is entitled to the thanks of every true lover of his species. It must carry conviction to the mind, and the publication is well worthy of an extended circulation."—*Bath and Cheltenham Gazette*, 24th July, 1838.

The following is an extract from a letter of the friend and associate of M. Orfila, the justly celebrated Toxicologist. "L' opuscule sur les épidémies, etc., à surtout occupè mon attention. J' ai eu, plus d' une fois, occasion de traverser en Italie, des contrèes malsaines, et j' ai lu une notice intéressante sur les expériences, faites dans certains marais de l' Amérique du sud, par un savant français, á l' effêt de determiner la nature de leurs miasmes pestilentiels. D' un autre côté j' ai été temoin à Paris, et particulièrement dans le temps du Cholera, de la confiance qu' on y a dans l' efficacitè de Chlore, comme principe eminemment disinfectant, et je suis parfaitement d' avis, que l' ingénieux appareil, dont l' introduction dans ce pays est due à Mons. Murray, doit desormais trouver place dans la valise de tout voyageur, qui se propose de visiter des contrèes sujettes à la Malaria."

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For subtilty of argument, I have neither inclination nor leisure: all that is, therefore, attempted in this pamphlet, is a brief sketch and condensed summary of the facts connected with the question of Epidemia, and Endemia; and their associates; chiefly in reference to *contagious* or *infectious* febrile disease, with a description of prophylactic means, safe, simple and effective.

This little treatise, it is hoped, is not rendered repulsive to the general reader, by an investiture of scientific formulæ; though intended to make the revelations of modern science, available and subordinate, if not altogether to prevent the inroads of disease, at least to impose a check on its diffusion or extension.

The great object of my life has ever been to make the streams of knowledge tributary to human enjoyment, or to allay human suffering; and I fearlessly appeal to the phenomena of chemical science, in this case, as my *point d'apui*, and guarantee for the validity of my statements and views.

June, 1838.

PREFACE TO THE SECOND EDITION.

The first impression was necessarily limited in its circulation, from the defalcation of its publisher, E. Wilson; but it has nevertheless been sufficiently lauded, to prove that its usefulness has been highly appreciated.

More than six months after my pamphlet was printed Dr. Bowring's assault on the strongholds of quarantine was submitted to public notice. I cannot but regard it as mischievous; and under the pretence of an intense anxiety to benefit commerce, he wages an indiscreet war against the laws and regulations of quarantine, while he dogmatically denounces the non-contagiousness of plague—the *questio vexata* of wiser heads than his. The whole drift of Dr. Bowring's lucubrations is evidentlyto do away with quarantines altogether. Their laws and regulations press heavily on commerce; therefore, reckless of consequences, they should be utterly abolished. They are severe in their individual operation: *ergo*—the health of the community must be sacrificed at the shrine of personal convenience! —Strange dialectics! Marvellous philosophy!

I have added much new matter in this edition; and the commentary on Dr. Bowring's speculations is consigned to the Postscript. The History of the Plague is the book of Death.

A DESCRIPTION

OF THE

PRESERVATIVE PHIAL

REPRESENTED IN THE PLATE.

This Preservative Phial is an improvement, by Boullay, on the original disinfecting apparatus of Guiton de Morveau, and generally employed in the Hospitals of France. It is several years since I brought with me one of these simple machines from Paris, and have repeatedly recommended their adoption in this country; but the principles involved in its application, being generally misunderstood, I have been induced to publish these remarks—Messrs. Brooke and Bishop, 13, Northgate-street, Bath, having consented, at my suggestion, to have the preservative phial manufactured. The public may, therefore, now be supplied by these highly respectable chemists. I have no interest in this affair, save the wish to do good; and I sincerely hope Messrs. Brooke and Bishop may be remunerated for their promptitude and alacrity in acting on this, my recommendation.

The lower portion of the preservative phial contains a box, which holds the phial, exclusion from light being essential. The latter receives the ingredients necessary for the development of chlorine, consisting of a mixture of peroxyde of manganese and hydro-chloric acid, a portion of cotton wool being loosely introduced into the neck of the bottle.

The superior part of the apparatus consists of a dome, with two lateral orifices, and accurately fits by being screwed on the box below. A screw, carrying at its lower extremity, and interiorly, a plate of flat ground glass, passes through the apex of the dome. When not in use, the circular plate of glass being in contact with the ground lip of the phial, the gas remains pent up; but as soon as this is raised, by turning the nut of the screw, the chlorine escapes through the orifices, and the quantity may be adjusted by apportioning the relative threads of the screw; while, by turning the screw in an opposite direction, the flow of the gas is altogether prevented.

REMARKS.

It is necessary that there should be a right understanding between the writer and his reader, as to the terms used by the former—conventional they may be, but, at any rate, they should be defined; and much confusion seems to me to have arisen for want of this definition. *Contagious* diseases are, *literally*, those that are communicated by *contact*, whether it be that of the patient labouring under a specific disease, or that of a bale of merchandise which may have absorbed the malignant miasmata from the atmosphere or some other source. Though the term contagion ought, therefore, to be thus legitimately restricted, it has been usually employed in a more vague and diffuse sense; and may not relate to positive contact with the subject of disease, but to its communication by a morbid effluvium proceeding from the body of the diseased individual—the contaminated atmosphere being the vehicle of transport and inoculation. This view of the case is evidently vague and ill-defined, for, strictly speaking, it is locally epidemic, the atmosphere of the place being morbidly affected. By INFECTION, we are, I apprehend, to limit the question to the communication, as in the case of plague, to individuals by spongy materials, or other absorbents, imbued with the germs of disease from their previous local exposure, and that are imported with them. Notwithstanding this conventional distinction, we still, however, say, an infected atmosphere or an infected district.

By the term EPIDEMIC we are strictly to understand, that kind of disease, of which the atmosphere is the exclusive medium of communication and of transport; while on the other hand ENDEMIC diseases are confined, by lines of demarcation, to particular localities, or are prescribed in their range by circumstances and conditions of place.

These views seem to me to be more tangible and precise, than the 'chance medley' use that has been made of them, and it would only lead to confusion, were they to be considered in the light of conveniently convertible terms. From this definition, it must therefore be evident that epidemic disease may or may not be aggravated by endemic circumstances; nay, it is even conceivable that the malignant nature of epidemia may be *attenuated* by local peculiarities; and, on the other hand, *endemic* disease may exist irrespective and independent of epidemia,—since the former may spring from the soil, or from stagnant waters, and even the geology of the strata may contribute its share in the aggravation. As connected with this assumption, it may be remarked that there is a district among the Cheviot Hills, where the sheep are subject to a peculiar disease, called *pine*, and removal from thence seems to be the only remedy. It is also obvious that both epidemic and endemic diseases may exist without the character of contagion, in its limited sense; and a disease may be *contagious*, which has a spontaneous origin and growth in the human constitution. Such seems to me to be a correct view of the case, and at any rate it simplifies the question, by making it more definite and distinct.

In our preceding remarks, it is stated, that endemic diseases are confined to specific districts, and truly local. A particular region of country, and specific class of individuals, comprise the circumstances and the objects of attack. In illustration of endemic assault two phenomena are specially prominent. The *Plica polonica* is confined, I believe, to a particular district of ill-fated Poland. It is a singular disease, and the question is still involved in considerable mystery. The hair is so gorged with blood, or other secretion, that even cutting it becomes not only a very painful operation, but is often attended with much danger,—*Bronchocele*, or what is called *goiture* on the continent, is another example. It is presumed to be a prolongation of the *Thyroid gland* and is familiarly known in this country under the name of 'Derbyshire thick neck,' though by no means peculiar to that county. It presents in some of the valleys of Switzerland, as in the canton of the Vallais; and in Savoy,—a truly formidable appearance. At Aiguebelle, I have seen this glandular swelling so hideous, that it extended to the knees, and in some cases it was found necessary to confine it in a bag and cast it over the shoulders. In some parts of Derbyshire, Bronchocele assumes a considerable size and interferes with symmetry, but in no case is it at all comparable with the magnitude, which the diseased gland frequently attains on the continent of Europe.—I have met with it of a sufficiently imposing character, in the vicinity of Pozzuoli, in the Kingdom of Naples. Even 'Cretinism' seems to possess somewhat of an endemic character, and in a pedestrian excursion I made some years ago, through South Wales, I was forcibly impressed with the occasional remarkable similarity there appeared to exist between some of the cases of idiocy there, and the *Cretins* of continental Europe. In the poor Cretin, the emphatic language of Scripture is mournfully verified, and is painfully expressive—"they have eyes but they see not, ears but they hear not, neither do they speak from their throat;" they are the automata of our species—the effigies and the wreck of poor humanity. Not only have the affections of the mind vanished, and reason suffered an eclipse, but the animal senses appear to have fled from their casement. The *Malaria* of the Pontine Marshes, and Maremma of Tuscany, is doubtless *endemic;* and it seems to be more energetic at *night*, because the *stratus*, or 'cloud of night,' then descends from its skyey elevation to the plain, and the superadded moisture aggravates its type by condensation or concentration ;—hence our '*vetturino*' would not suffer us to repose by night in traversing the Pontine Marshes. Between the hours of eight and nine o'clock, I always found the streets of Leghorn deserted; and discovered, on enquiry, that it was on account of the 'malaria;' as if it then stalked abroad like an 'ill-used ghost,' and knew 'its appointed time,' and paid its 'hourly visits.' I, however, gave little heed to this assumed chronometry; and the then vice-consul (Mr. Brown) and myself were often beyond the gates even at the 'witching hour.' The sentinels knew us, and we passed at all hours, but never met with any personification of malaria, nor did either suffer injury.

When at Rome, during the autumn of 1818, the malaria rioted in a street contiguous to that where I resided—the '*Strada di Condotti.*' It was very fatal in that district, but all the rest of Rome was entirely free from its influence: the lines of demarcation were strongly marked.

In further evidence of endemic disease, I might refer to the malignant fever of Walcheren, and the intermittents or agues of our own fens—now, happily, less rife and more rare.

The *Plague*, which is likely *endemic* in its source, there can be little doubt is also *contagious*. But it ought to be considered here, that for an individual to be affected by mere contact, it requires some peculiar susceptibility in the functions of the absorbents—the mouths or orifices of which are connected with the surface of the skin—or some peculiar idiosyncrasy of constitution. This seems to be an obvious deduction from the well-known fact, that perhaps only one individual among numbers shall be affected, while the rest escape, though they may have been equally exposed. It should be remembered that the simple sense of touch, in some individuals, is exquisitely susceptible:—I was personally acquainted with an extraordinary case of this kind, wherein the incidental contact of *rice* was followed by consequences the most serious—the effects being those of a virulent poison. Some, on the other hand, illustrate the converse of the proposition. It is quite evident that these extreme cases would be very differently affected by contact with an individual, the subject of disease. In many cases, however, it may be difficult to determine what measure of the invasion of disease is fairly attributable to the simple contact, and how much may be due to the absorption or respiration of the contaminated atmosphere of the room where the patient lies; and which may either enter the system by the orifices of the skin, or the air passages of the lungs;—and in predisposing habits of constitution, or the reverse, 'contingently contagious,' are terms which have been employed. The death of the nurse who attended the cholera patients at Sunderland has since been cited as an evidence of the contagious nature of cholera; but from preceding remarks, it must be logically considered as a *nonsequitur*. Dr Scott, on the other hand, gives an example of a mother having fallen a victim to cholera, while the infant she suckled entirely escaped; and in my little work on Hydrophobia, I have cited a very remarkable analogous case, communicated to me from a personal knowledge of the circumstances. The mother fell a victim to Hydrophobia some time after having given birth to a son, who now lives, and is nearly thirty years of age. The bite was inflicted by a rabid dog during the pregnancy of the mother.

As a proof of the contagious nature of plague, Sir Arthur Brooke Faulkner, in his 'Treatise on the Plague,' mentions that in the Hospital at Moscow, all the assistant-surgeons who dressed the wounds, took the plague, while the physicians, who simply walked through the wards, and *inspected* the sick, escaped. Dr. Charles Maclean, who owes his chief celebrity to having inoculated himself for the plague, may fairly ridicule inspecting plague patients through a telescope or an opera-glass, and feeling the pulse through a tobacco-leaf—the penalty of a long quarantine being imposed in default; while the injunction of dipping the hands into vinegar, is equally absurd. But his reasoning, if indeed it deserves the name, is of a most extraordinary character.—Our author is at a loss to conceive how members of the College of Physicians in London, who have never explored the regions beyond the sources of the Thames, the Cam, or the Isis, can intuitively possess a knowledge of the Malaria which desolates the banks of the Ganges, the Nile, or the Bosphorus. The question, though at first sight natural enough, may be fairly reflected back on himself; for how came it to pass, that he had formed his opinion on the non-contagious nature of plague, ere he had ever left his native shore?

Dr. Greaves, in whose house Dr. Maclean resided while at Malta, in a letter to Mr. Tully, accuses him of withholding facts which militated against his preconceived views. Not only was the fact stated explicitly by Dr. Greaves to Dr. Maclean, but the former even conducted him to the spot. This circumstance when pressed on Maclean is admitted, and he observes, 'had I noted all similar narratives which I heard in the course of my researches, they would have filled many volumes!' The fact alluded to by Dr. Greaves is this:—'soldiers secluded in the upper part of the hospital invariably escaped, whilst the inhabitants of the lower part of the same building, not secluded, generally sickened, and, for the most part, died.' Dr. Maclean incessantly ridicules *opinions*—'what signify opinions?' quoth he, and lustily bawls out for *facts*. Well, then, here is a fact, and a stubborn one too; and if he could have 'filled many volumes' with facts like these, it would have required a brighter genius than Dr. Maclean seems to possess, to have overturned their testimony.

Dr. Paris says,—‘ the fact is, Dr. Maclean determined on the plague being non-contagious long before he ever visited those countries where it prevails;’ to this Dr. Maclean replies,—‘ I did at any rate afterwards visit those countries, in order to ascertain whether my theoretic deduction admitted of practical confirmation.’ Now this is just Lord Bacon’s maxim of induction turned upside down. The sum of the matter is this—Dr. Maclean caught the plague in his own person, in the Greek Pest Hospital, at Constantinople, on the fifth day of his entrance, and narrowly escaped with his life. One would have supposed this an *argumentum ad hominem*, and sufficient to have staggered a wiser head than that of Dr. Maclean. But, as Sir Hudibras says

> “ He that’s convinced against his will,
> Is of the same opinion still.”

Our hero, in reckless foolhardiness, subsequent to this, inoculated one of his great toes with Ichor, from a Buboe, the toe dropped off; and his escape in this instance is entirely to be attributed to ‘case hardening’ from his previous seizure. M. Von Rosenfeldt, in 1816—1817 conducted some experiments in the Pest-house at Pera, and on the 38th day was seized with plague, and died. Dr. Valli, also, died there in about five weeks. Dr. Maclean’s process of reasoning in these cases, is a very curious one—quite *sui generis* though of a piece with the rest of his logic.—This was the period in which Maclean himself was seized—He escaped, and others fell victims in *different periods*,—ergo, plague is not contagious, Q. E. D. :* according to him, all should have been attacked at the same moment after contact. I cannot but think, however, albeit our logician, that disease, even plague itself, is obedient to no such refinements in chronometry. Hydrophobia and other diseases lie dormant in the system for various periods, in different constitutions, till some circumstance, or some physical change rouses the morbid germ from its slumber. In reference to a comparatively recent visitation of the plague at Malta, the late Dr. Hennen, a physician in the Mediterranean, mentions a very curious fact,—namely, that in four or five years immediately preceding : hydrophobia occurred, "with a frequency and violence never before observed, and many individuals perished in a state of hydrophobia." It is added, that sudden deaths were also much more frequent. It will be remembered, that in this country some years ago, hydrophobia was more prevalent at one period than had been known for many years previously, thus linking both with meteorological phenomena ; a view I have elsewhere sustained.

I have perhaps rested unnecessarily long on the subject of exotic disease ; but it is to introduce some cursory remarks on the question of QUARANTINE, from the Italian word *quaranta*, so called from the period of duration being a term of *forty* days. The quarantine laws, enacted by a wise and enlightened policy, were established after the plague of the 14th century; first in Lombardy and Milan, in 1374, and subsequently adopted by the Venetians, in 1484. As a practical evidence of their benefit, it may be stated, that though the plague rages annually in the Levant, yet Spain, Italy, and France are free. We have enjoyed an immunity from this scourge for more than a century and a half, but Malta had remained also free for a period of 138 years! when, in the year 1813, the plague was introduced into that island by means of some contraband goods, the owner of which and his family fell the first victims. *Lazarettoes*, where quarantine is enjoined, are established at Odessa, Malta, Leghorn, Genoa, Marseilles, &c. Plague is allowed on all hands, except by those who are wilfully blind, to be contagious. Of nineteen medical men who gave evidence before a committee of the House of Commons on this question, there were only two dissentients; and but for Dr. Mitchell, Maclean would have moved *en solitaire* in an orbit of his own. Dr. Bulard who performed such eminent services during the plague in Turkey and Egypt, is now at Berlin. Sixteen years study of the plague, the treatment of upwards of 30,000 individuals, and the post mortem examination of 400 bodies, have convinced him that PLAGUE is CONTAGIOUS, and that many circumstances facilitate the communication.

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* Even supposing it questionable whether plague be really contagious, as a judicious medical friend once observed to me—"it is our duty to act as if it were so."

In the Jewish economy, we discover that sanitary and salutary laws were enjoined, as in the case of the leper, to prevent contagion or infection,* and thus have the highest of all authority, as our precedent in this important matter. It is at our peril if we relax the requirements of this *cordon sanitaire.* Sir Gilbert Blane has well remarked—"is it to be endured that by a piece of cavilling sophistry, a monster shall be unchained, which, in the course of a few years, has devoured more than half a million?" It may press hard on individuals, but is the community to be destroyed?—no! 'better to bear the ills we have, than fly to others that we know not of.' Were such a destroyer to be let loose on the population of Great Britain, we should find, when too late, ample cause to repent our temerity; and though the habits of the people and their mode of living might modify the disease, yet plague, even in its mildest type, would be a fearful visitation, and its extinction 'a consummation devoutly to be wished.' There are, unhappily, individuals among us who would relax the sinews of our safety, by abrogating the quarantine laws—such an abolition, however, would be little short of madness, and of suicide. Our freedom or immunity from this terrible visitation which has so often desolated other countries, may be very reasonably ascribed to the operation of those very laws which a reckless hypothesis in its subtility would dissolve. "We want something of the kind!"

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* Leviticus, chapter xiii. v. 14.

once observed an eminent physician to me. Commerce may complain that she is fettered by the restriction, and her resources crippled; but commerce is also aware that her resources were embarked under this drawback, and with full cognizance of its operation, and the account of profit and loss balanced accordingly. The coffers of commerce might be replenished, but our children would be consigned to a premature grave. Plague compared with cholera would be as the thunders of the storm compared with the whistling of the reed! It will be inferred from these observations, that I am a firm and unflinching advocate for the continuance of the quarantine laws, and I can discover no justifiable pretext for their relaxation. On *scientific principles*, the period doubtless may be safely abridged, and the quarantine regulations modified with advantage. It does not appear that plague changes its malignity by transport or change of place; or decrease of temperature in higher latitudes. The plague at Moscow carried off 87,766 persons. That which raged at Cadiz in 1800, and which was probably an importation, was called the *yellow fever:* its mortality was dreadful. In the same year, Genoa was visited by a kindred disease, which carried off 500 persons daily.

The plague was introduced at Marseilles in 1720, and in consequence of the physicians at Paris having decided against its contagious nature, no precautions were adopted, and in the course of *seven months*, 60,000 fell victims to the destroyer! The same insane perversity of opinion occurred in that which raged at Messina, in the year 1743, and 43,000 persons perished! In reading the history of the plague and its introduction into various countries, it is impossible not to be forcibly impressed with the conviction that its germ may be clearly traced, as an article of import into some seaport town, and especially those whose commerce brings them into more immediate contact with the Levant, the cradle of the destroyer. The medium of its introduction may be some invalid on board ship in the harbour, or some bale of merchandise smuggled on shore. Hence Marseilles has been the scene of repeated desolation, together with Genoa, Messina, Cadiz, and others; for these have in turns shared in the ravages of the plague. According to Gibbon, it is by no means incredible, that, in the Roman Empire alone, ONE HUNDRED MILLIONS fell victims to the ravages of the plague, which occurred in the reign of Justinian. The historian has graphically sketched its rise and progress, as well as the phenomena and consummation of the disease. "The fatal disease which depopulated the earth in the time of Justinian and his successors, first appeared in the neighbourhood of Pelusium, between the Serbonian bog and the eastern channel of the Nile. From thence, tracing as it were a double path, it spread to the east, over Syria, Persia, and the Indies, and penetrated to the west, along the coast of Africa, and over the continent of Europe. In the spring of the second year, Constantinople, during three or four months, was visited by the pestilence; and Procopius, who observed its progress and symptoms, with the eyes of a physician, has emulated the skill and diligence of Thucydides in the description of the plague of Athens. The infection was sometimes announced by the visions of a distempered fancy, and the victim despaired as soon as he heard the menace, and felt the stroke of an invisible spectre. But the greater number, in their beds, in the streets, in their usual occupations, were surprised by a slight fever, so slight indeed, that neither the pulse nor the colour of the patient gave any signs of the approach of danger. The same, the next, or the succeeding day, it was declared by the swelling of the glands, particularly those of the groin, of the arm-pits, and under the ear; and when these tumours were opened, they were found to contain a COAL or black substance of the size of a LENTIL. If they came to a just swelling and suppuration, the patient was saved by this kind and natural discharge of the morbid humour; but if they continued hard and dry a mortification quickly ensued, and the fifth day was generally the term of his life." It is not improbable that it was a disease analogous to the cholera, which thinned the ranks of Sennacherib's army, during the night of his fatal encampment, as well as that which destroyed the first-born of Egypt.

The *rapid fatality* of the disease with which the destroying angel visited the camp of Sennacherib, and the dwellings of the Egyptians, seems to prove it was not plague. In both cases, *one night* completed the duration of the disease. The "pestilence" which swept the kingdom, during three days, in the reign of David, may have been plague;—and, "there fell of Israel, SEVENTY THOUSAND MEN." In the years 1346, to 1352, the plague devastated Europe—nay, laid waste the world; for it has been computed that the earth was thinned of ONE-HALF THE INHABITANTS ON ITS SURFACE. The colder regions shared the common fate. China has been presumed as its source,—crossing Tartary it extended its ravages to the Caspian and even the Sea of Azof. Constantinople and Egypt were visited in its progress, and subsequently Greece, Italy, France, and Africa. In that year, Scotland, England, and Ireland, were tributaries to the common calamity; and in the following year, Germany, Hungary, and Denmark, poured forth their victims. The plague broke out at Dantzick, in 1709, and extended to Hamburgh and Copenhagen:—facts which prove clearly that plague will luxuriate in higher latitudes, and that cold, though it may paralyze, does not destroy it. I remember when at Turin, during the winter of 1818-19, a dreadful pestilence rioted in that city, and from the number of victims, it was a Necropolis or 'city of the dead.' It seemed to be a kind of typhoid plague, yet the weather was so severe, that the water-bottle in my room was fractured by the freezing of the water. The British metropolis was visited by this scourge in 1665, and in reflecting on its eventful history, there is one peculiar feature which may be mentioned; it made its appearance first in the parish of St. Giles, towards the close of 1664; it remained dormant from Christmas till about the middle of February; awakened in that month, became dormant again, and re-appeared in the month of April in the same district; so that the severity of winter had

> '————Scotched the snake,
> but had not killed it.'

In 1665, the number of victims amounted in all to 68,000, and of these, no less than 46,000 perished in the months of August and September.

In the case of typhus fever, I believe it has been acknowledged, that infection may be communicated to an individual at a distance of two or three yards. This, however, will necessarily depend on circumstances,—a stagnant atmosphere, in the absence of ventilation; or in the case of a current of air, the windward or leeward side of the patient, will determine escape or seizure. It has indeed been contended that typhus fever is not contagious, and is merely epidemic; but I remember to have met with a case in the course of my reading, which proves this opinion fallacious. The fact, which was well authenticated, relates to an individual at a considerable distance from home who was seized with typhus fever.—His relations lived in a dry and elevated spot, and in a district where typhus fever had never been known to occur.—The patient was removed thither, and the consequence was, that the several inmates were seized with the same disease. Now, the difficulty in the question of typhus fever seems to be simply this.—It may be only contagious at a *certain stage* of the disease,—*i. e.*, in a relative degree of maturity, which seems to be the case in hydrophobia; and further, it may also depend on a particular constitutional predisposition on the part of the person brought within the sphere of its influence; the epidemic phenomena may also be attenuated or aggravated by a proper ventilation, or the want of it, while local circumstances may modify both. It is by no means improbable, that the plague, the yellow fever, (*typhus icterodes*,) and typhus fever are offsets from the same root; the comparative degree of virulence being dependant on collateral circumstances, as those of heat and moisture. The 'prison fever' (*Febris carcerum*) is admitted to be typhoid; and unless we believe it to be a contagious disease, it is scarce conceivable that its influence could have been so generally destructive and extensive, as was unhappily proved to be the case at Cambridge assizes, in the year 1522, when so many died;—and, above all, at the assizes held in the castle of Oxford, in the year 1577, called the 'black assize,' when the judges and almost all present, to the number of three hundred, were destroyed. And to come down to later times, we may refer to the sessions held in the 'Old Bailey,' in the spring of the year 1750, which proved fatal to the Lord Mayor, two of the Judges, besides others.—With these facts before us, and many more equally conclusive, we cannot reasonably doubt, at any rate, of the *infectious nature* of typhus fever—the consequence of a contaminated atmosphere, whatever opinion we may form of its contagious character, in its more restricted sense. That typhus fever is endemic in its origin, and may be propagated epidemically, seems to admit of little doubt, and it appears equally obvious that its fixation to particular localities, is ascribable to endemic circumstances; while predisposing causes and idiosyncrasies may exist to render the system of particular individuals more susceptible than that of others. The escape of the many from the influence of contact or the infected atmosphere, proves nothing. There is certainly nothing in the belief that morbid effluvia, arising from the body of a typhus patient, should, by being received through the medium of respiration, or the orifices of the skin, communicate the disease to another, than that the febrile miasm might be imparted directly and immediately by the common atmosphere in the ordinary act of respiration. The difference would be merely this; the air of the sick-room is more aggravated and noxious, and the chances of escape are lessened; for the more condensed and concentrated the morbid principles are, the firmer will be their grasp on the constitution. The pestilential miasmata of the Walcheren fever were influential at the distance of a quarter of a mile from the shore, as was proved to be the case in the crews of vessels being affected to that extent. One of the officers of that unfortunate expedition, Captain Snape, of the 63rd regiment, informed me that he ascribed his entire freedom from attack, to the constant use of a cigar. To this plea, however, I demur. Our military friend stated that the water used for constant beverage was so full of insects, and even of maggots of no ordinary size, that the teeth had to be too frequently employed as a substitute for a strainer or filter!—No marvel, then, that the miasm from such stagnant and putrid waters should be followed by pestilence. In this case, it is evident that the febrile miasmata of Walcheren acted on the constitution at a much greater distance than the virus of small pox, measles, or scarlet fever. Endemic in the pestilential swamps of Walcheren, it was transported by the air and became epidemic.

That small pox is contagious cannot be denied; the fact of inoculation is decisive on this point; because it is conceivable that contact with the absorbents of the skin may be quite sufficient to impregnate the system. Inoculation is unconnected with the functions of respiration, and gives rise to an eruptive disease of the same type and features of that which supplied the ichor introduced into the system; itself obtained from a remote source. In this case epidemia cannot be pleaded, for the ichor may be preserved hermetically sealed up in a bead of glass for many years, and transported to another hemisphere.

Of the nature of the miasmata, or particles or principles constituting the morbid materialism of the atmosphere and of that which inflicts the fatal scourge on the human constitution, honesty compels us to confess, that to this hour we are entirely ignorant; and chemistry, with all her eudiometry, and her refinements in manipulation, can yield no information of its nature;—a subtile being which her apparatus can neither catch nor confine. Subtilest of all poisons, indeed, it seems scarcely to own a material existence. 'The terror by night' presents to us no visual form, nor can we trace here "the arrow that flieth by day." "The pestilence walketh in darkness," and we perceive it not; and "the destruction wasteth at noon-day;" but the destroying angel is compassed by a cloud.

The *chemical* constituents of the atmosphere, in these cases, continue the same, but its electric condition is changed. We are doubtless to regard the agent that produces these wonderful effects as one extremely subtile in its nature, possessed of great virulence and malignity, extraneous or foreign to the chemical constitution of the atmosphere, that medium being the mere vehicle of transport, or means of its solution; and therefore conclude that these principles of malignant disease are made more aggravated, and determinate in their attack on the constitution by the conditions of heat and moisture. Both of these will modify the electric character of the atmosphere, and predispose the animal frame to its attack. Heat may increase the energy of the germs of disease, while moisture will make its agency by contact more direct and immediate by imparting to it as it were a new *animus*.

The *campagna di Roma*, and the *maremma* of Tuscany are regions where 'malaria' luxuriates and is rife. Rich people, to avoid the invasion of disease fly to the attics, and leave the poor below. I had a letter of introduction to Signor De —— of Genoa, and had to climb several flights of stairs before I found him, enjoying the *otium cum dignitate* of the attic. There can be no doubt that the lower stratum of the atmosphere, during evening, and night more especially, is the most insalubrious, and it is quite accordant with my personal observations, that at comparatively inconsiderable altitudes, we may escape the contaminating influence of the unhealthy region. The influence of vegetation on the atmosphere, and in relations like these is far too feebly estimated. The intervention of a myrtle hedge will arrest the progress of malaria. I think that malaria, *cæteris paribus*, will been hanced in its malignity, as the hygrometry of the atmosphere ascends above the 'dew point,' and *vice versa*, as it descends beneath it. Let it be understood, however, that *moisture* is not the *virus*, but its vehicle;

that which condenses and concentrates, and thus becomes the *medium*, whereby the system is inoculated; and we know that nascent chlorine is most effective on coloured surfaces through the medium of moisture.

That typhus fever, cholera, and perhaps scarlet fever are connected with epidemic circumstances, there can be no doubt; and I think there can be as little scepticism on the fact that local phenomena may modify their type. A few years ago, typhus fever prevailed to a considerable extent in some localities in Yorkshire.—'Rushworth school' was broken up in consequence; it invaded the domain of the 'Friends' school at Ackworth, and from one hundred and sixty, to one hundred and seventy of the inmates were at one time under the influence of the disease. In some, the type was of a mild character, but in others it assumed a more malignant form.* By the judicious application of chlorine on my recommendation, a seminary near Huddersfield, where the typhus fever prevailed, was entirely protected.

Many cases of cholera and typhus fever may be distinctly traced to local causes; some cesspool, or stagnant water for instance; and such should be ever regarded with a jealous eye, and got rid of as soon as possible. Many malignant and fatal attacks of typhus, I can very clearly trace to some such cause. The individual case of Mr. Day, a schoolmaster, at Clapham, is much to the point, and this solitary instance it may suffice to quote, as it is by no means intended to make these "remarks" a *catalogue raisonné* of cases. On the 14th of August, 1829, one of his sons was attacked with the usual symptoms of cholera, and died in three hours. On Monday 15th, twenty out of twenty-two boys were suddenly affected, and many of them threatened with immediate death. On that day, another of Mr. Day's sons fell a sacrifice. The boys were removed by their friends, and all recovered in the course of the week. It was conjectured that they had taken poison ; but the true cause was discovered to be a very foul drain and cesspool, behind the house, not previously known, but which had been opened. Its contents had been removed to the adjoining garden separated from the play-ground by a low paling. The younger boys were most severely affected, while a man who fell into the cesspool, escaped altogether the endemic infection.

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* I was informed that many of the parents and relations of the children who visited them at Ackworth School, on their return home carried the germs of the disease with them, and became the several centres of its diffusion.

A pestilence of the most fatal character has lately broken out among the aboriginal Indians, in the western and south-western confines of the United States of America. It attacks the head and loins, and the victim succumbs in two hours !—within a few weeks upwards of 33,000 Indians have fallen on the *prairies*. Of 1600 Mandans, only 35 remained alive. 10,600 Assineboins have fallen.

The raven and the eagle are the undisputed tenants of the mournful desolation which now reigns over these Indian forests and '*prairies.*' The 'crows' and 'black feet' tribes have suffered dreadfully, and more than one tribe of warriors has been summoned to the tribunal of 'Manitoulin,' the GREAT SPIRIT. This terrific pestilence is supposed to be analogous in its character, to the 'black death' which prevailed in this country some centuries ago.

By the numerous victims to cholera in the eastern hemisphere, there were scarcely left an adequate number of devotees to drag the murderous car of the Moloch Juggernaut, and thousands of pilgrims were struck dead, while kneeling at the tomb of the "prophet."

Contrary to the opinion of the late Dr. Mac Culloch, we trace the causes of Malaria chiefly to stagnant masses of water, holding in solution decomposed animal and vegetable matter; while running streams and transparent lakes, agitated by the breeze and replete with a healthy aquatic vegetation, as water-lilies and their congeners, the *potamogeton*, *ranunculus*, and the *lemna*, all evolving oxygene in the sunbeam, together with the mountain torrent and the bubbling spring are exempt from the charge. Dr. Mac Culloch, however, says that "it is scarcely less in clear waters, under whatever form producing living vegetation, than in putrid stagnant waters." —Lakes, ponds, rivers, canals, ornamental waters, and all "the endless ponds and pools all over the country," are included in one condemnatory swoop. His diatribe is thus directed against one of our chief sources of pleasure, and the loveliest feature of ornamental landscape. Dr. Montfaucon however entirely confines his views to stagnant water containing decomposed organic matter, and I think he is right.—The 'alpen jager' contends uninjured with the debachle; the river and the rivulet fertilize the plain, and the ruddy glow that animates the cheek of the tenant of the valley proves incontestibly that Dr. Mac Culloch's assumption is founded in error. The cultivation of rice, steeping of hemp, flax, &c. are sources replete with malaria infection; but how *sugar*, as instanced by Dr. Mac Culloch, should become a source of malaria, I cannot understand. Montfaucon gives two cases which entirely militate against his statement, as to the difference between "living waters" or a running stream, and stagnant water. The Arabs wished to punish the inhabitants of Bassora for an insult received: they diverted the river which washed the walls of the town from its course—marshes were thus formed, and 14,000 perished. In a hamlet where the inhabitants were accustomed to steep their flax in pits, they were annually subject to intermittents. Mr. Bourges, advised them to steep their flax in a running stream, they did so, and their endemic fever disappeared. It however returned, and it was eventually discovered that an inhabitant had used a pit for this purpose; the cause was again removed, and the fever did not return. I entirely ascribe the accession of a malaria fever which I caught near Ferrara, in Italy; to this cause, namely, the swamps around the town, wherein they were steeping hemp. It may now be added, that *miasmata* is a plural term, that has been applied to those noxious exhalations which become the means of impregnating the system with the seeds of febrile disease; from the malignant plague of Egypt, down to the intermittent of the mildest type, through all the gradations of the yellow fever, typhus fever, and remittents. Two causes have already been assigned as agencies which aggravate or otherwise modify their action,—viz., heat and moisture. In this country, typhus fever and intermittents are more rife from June to November, when heat is combined with autumnal moisture. Indeed, neither heat nor cold is so operative as *moisture.* The plague of Egypt is most frequent after the inundation of the Nile, while on the other hand, the arid *harmattan* checks the progress of many diseases. The plague attacked the French army, in February, 1800, under the walls of Jaffa, when the atmosphere was particularly humid. We may suppose the miasmata of epidemia to be specifically lighter than air, and in this case it is very evident, that but for the moisture or aqueous vapour of the atmosphere, which entangles and condenses the subtile elements or *molecules*, they might rise beyond the reach of ordinary respiration or cutaneous absorption.

DISINFECTION.

It is needless to premise that there exists a common misunderstanding on the important means to be used as effective in disinfection:—the burning of tar-barrels, and fumigations of vinegar, cannot, on any sound principles of reasoning whatever, be admitted as either efficient or safe. Camphor, burning pastiles, and aromatic and odoriferous materials, rather aggravate the evil, by acting as subtile vehicles, whereby the system is more certainly inoculated. Thus, for instance, the action of opium is more prompt and determinate when combined with vinegar—a fact well known to Turks and Persians, and substantiated by the experiments of Orfila. Camphor,* sometimes worn as a kind of amulet or charm, is quite as foolish and as absurd as the *arsenic* worn on the person, during the plague of London. Vinegar, thrown on live coals, or a heated plate in crowded Courts of Justice and the like, forms only a temporary covert for the animal effluvia, which is merely for a short time overpowered, and is soon felt as energetic as ever.

* The Physician's staff, on which he reclined in former times, as if it were his oracle, concealed at top a cavity containing camphor.

Explosions of gunpowder are certainly much less objectionable than the combustion of tar barrels. Discharges of cannon, or musketry, not only affect the tranquillity of the air, by the concussion imparted to the atmosphere, and may thus be greatly serviceable in a stagnant medium,—but it is well known that an electric character is thus imparted to it; for, during the discharge of the cannon in St. James' Park, the windows of some of the government offices are found to have electricity imparted to them. Still, I doubt whether such influence can be otherwise than temporary and limited. Certainly, the notable expedient of wearing little bags of camphor is as trifling and vain as the amulets of scraps from the Koran worn by the followers of Mahomet, or the *Fetiches* of the sable population of Africa. In Glasgow, during the prevalence of cholera, the wisdom of the authorities there, ordered the walls of the houses to be washed with chloride of lime! the effect of which was the formation of a permanent *deliquescent* salt, the hydro-chloride of lime, of most injurious tendency.

In disinfecting means and measures, nothing can be rationally depended upon, short of the DECOMPOSITION and CONSEQUENT DESTRUCTION of the noxious and lethal miasm, and nothing is chemically known to effect this, on the requisite practicable scale, but NITRIC, or NITROUS ACID, and CHLORINE. All these will destroy by decomposition that septic aerial poison sulphuretted hydrogene—as well as arsenicated hydrogene, the experiment with chlorine being at once striking and beautiful; and I have had also ample experimental evidence in its neutralizing the fatal effects of Hydrocyanic or Prussic acid, and other subtile poisons.

It ought to be premised that in some cases where the chloride of lime has been used, its apparent inefficiency may be reasonably ascribed to its want of requisite strength, the noxious miasmata being more than sufficient to overpower it, thus leaving an excess of the destructive principles to act injuriously on the constitution. I must therefore assume, and facts bear me out in the assertion, that the occasional seeming want of success, has by no means proceeded from any want of virtue in the *chlorine;* or *chloride*, but solely from the lack of sufficiency in strength and measure. Where the aerial miasmata gain a predominant ascendency, it requires a proportionably greater quantity to counteract and entirely to neutralize the morbific principle. The Penitentiary, at Millbank, required a considerable mass of disinfecting materials, but the experiment was entirely successful; the malignant principles which rioted there were destroyed; and have not since invaded its walls: *chlorine* was the agent employed. It should be observed, that the chloride of lime may do for a confined space, the atmosphere of which may be deteriorated by only a slight impregnation, and perhaps the *dry chloride of lime* is to be preferred, if the atmosphere could be condensed as to its extraneous matters by a diffusion of water in divided streams, as through the rose of a watering pot. I should much doubt, however, whether anything short of *nascent chlorine*, would do much good in general cases. As to the efficiency of the latter, the experiment instituted by Mr. Abernethy is entirely conclusive. Portions of vaccine matter being exposed to the action of chlorine, were found to be entirely inert when introduced into the system, while other portions taken from the same source, and not previously so exposed, were perfectly efficient.—And the *bold* experiment made by Mr. Rose, in the case of the French Commission, (of which Messrs. Parisait and Rose formed a part) appointed to institute a series of enquiries concerning the plague in the Levant; is equally striking and satisfactory as to solutions of strong chloride of lime. Mr. Rose wore in contact with the skin, for several days, the inner garment of a person who had just died of the plague, and stained with plague-spots. This garment had been simply steeped for a short time in solution of chloride of lime.*

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* The Rev. Mr. Heilmann, of Holstein, states in one of the Danish periodicals, that his grandfather, who was practising as a physician at Hamburgh, in the year 1711, when the plague was raging there and carrying away thousands, effectually protected his own dwelling against infection, by placing a vessel full of TAR just inside his street door, and directing a hot stone to be frequently thrown into it. Thick fumes consequently rose from the vessel, and it was remarked that the expedient not only preserved his own house, but the residences of his immediate neighbours, in a most effectual manner, from the contagion. This plan was tried by a number of persons at Berlin, and with success.

The agency of chlorine in a nascent state is *three-fold.*

I.—It chemically *decomposes* the destructive miasm.

II.—It alters the electric character and condition of the atmosphere, for it superinduces, an electro-positive change, and neutralizes the tainted atmosphere of the sick room ; which, it is well known is invariably possessed, (as well as that of the Pontine Marshes, and the Maremma of Tuscany,) of negative electricity, and

III.—It acts in a hygrometric relation.

Colours are not at all affected by perfectly desiccated chlorine, while the change is immediate when in contact with moisture. The agency of disinfecting means is not generally understood, and chlorine has not been viewed in this *threefold relation.* The action of dry chlorine on the skin is also very remarkable—inducing a singular warmth—the increment of temperature being considerable.

Both Dr. Carmichael Smyth's plan, and that of Guiton de Morvean, in reference to nitrous acid gas, and chlorine, have been so triumphantly proved successful on a large scale, that scepticism on this important subject is completely disarmed. In proof of my assertion, I may appeal to the experiments made under Dr. Smyth's directions, with the former disinfecting agent, on board of the "Union" Hospital Ship, at Sheerness, on the 24th November, 1795. There were nearly 200 sick on board, and

150 of these are described to have been in different stages of malignant fever extremely contagious, as seemed evident from its rapid progress and fatal effects. The final results completely proved that the malignity of the disease was diminished, as well as the infection removed.

It cannot be irrelevant to introduce some allusion to *Hydrophobia*—a name more full of terror than any other, and the very personification of AZRAEL, the angel of death. Without a doubt, the prophylactic means in our power are ample and effective. CHLORINE is the only recognized agent that merits our unreserved confidence. As to the curative means recommended, they are founded on sound principles; and I have only, therefore, to add, "*Experimentum fiat.*" I deprecate the usual routine, and often tried formulæ, for "*exeunt omnes*" is the invariable sequence; at the same time, with untried means within his reach, the medical practitioner ought not to despair. Our great lexicographer has well remarked—"From torpid despondency can come no advantage; it is the frost of the soul which binds up its powers, and congeals life in perpetual sterility. He who has no hopes of success, will make no attempt; and when nothing is attempted, nothing can be done."

It would be egregious trifling to theorize on the subject. Opinion, in all its chameleon hues, has passed over the question; but, I take for granted, that every one who has studied the subject must be convinced that hydrophobia (a term, by the way rather a misnomer) is excited by the injection of a *specific virus* into the wound, and has nothing to do with the *geometry* of the teeth which have inflicted the wound ;* neither is it an *imaginary* disease—a phantasm of the brain.

It has been said, that a Roman physician had proved, by a train of observations, that the *animal alone*, in which the *rabies* spontaneously originated, was capable of communicating the disease; and that the *secondary* subject of the disease could not perpetuate the *rabies* by the infliction of a wound. There are analogies that go to prove that, under similar circumstances, the original power of the *virus* may be thus attenuated or weakened ; and, after each repeated wound of a venomous reptile, the power is more and more attenuated, till the wound at last becomes harmless. Still, after all, I think it will be found that the communication of hydrophobia will depend on the *relative maturity* of the disease ; and, in corroboration, it may be remarked, that *every bite* of a rapid dog is not *necessarily followed* by hydrophobia. But, though I admit all this, yet I consider it a sacred duty to treat the wound of the patient as if it were to be actually succeeded by the disease in every case.

When a person is unfortunately bit by a rabid animal, the part is usually excised; and this practice is considered the *safest* and the *best.* I confess, however, candidly, I do not think so. Hydrophobia is known to have supervened in such cases. Besides, if excision be not performed *immediately* after the infliction of the wound, or the manipulation be *unskilful* (for instance, not sufficiently *deep)*, it might induce a false and fatal security. Moreover, wounds are *frequently* inflicted where the scalpel cannot be safely or efficiently used.

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* This extraordinary idea was sustained by a critic, in the *Westminster Review ;* as if the *pyramid* or the *cone*, and its truncations, determined the question, and thus resolved itself into a geometrical problem !

As for the application of "caustics," such as *nitrate of silver*, *potassa*, &c.—and, I will add, even the *actual cautery*, as well as *moxa* and its congeners, —it is IRRATIONAL, and *trifling*, in the worst sense possible of the terms. At best, these merely *sear the surface*, and destroy the cuticle; while the functions of absorption operate unrestrained beneath.

I see no necessity for excision, so problematical in its issue; and I have no terms sufficiently condemnatory of the unmeaning and absurd practice of the application of escharotics in this case.*

The wound should be suffered to bleed freely, and for the purpose of aiding this, be scarified: ablutions of cold water may be also employed. This process ought to be succeeded by the *cupping-glass*. In the absence of the latter, the wound may be

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* Mr. Harrison, a surgeon of Camden Town, was bitten by his own dog, and the parts were *immediately and carefully excised*,—notwithstanding this, he died rabid. Alexander Eden, of Leith walk, Edinburgh, was bitten by a mad dog, but he, too, died rabid, though the parts were skilfully cauterized. These facts speak volumes!

SUCKED, where it can be done, with the most perfect safety, if the skin of the mouth and lips be not abraded; and, by way of precaution, the mouth may be previously rinsed with nitromuriatic or even nitric acid, in tolerably strong solution. In the absence of either of these, *alum* would corrugate the abraded surface. I do not say that I would suck the wound save in the case of any of the members of my own family; but in this instance I would not hesitate a moment.* In the Nicobar Islands, and elsewhere, the wounds of the most deadly serpents are sucked with safety and success; our own annals supply a similar instance in the example of Eleanor of England; while the direct experiments of Mangili and others clearly prove that animal poisons may be swallowed with impunity. Subsequent to the treatment recommended, the wound is to be *soaked* with a concentrated solution of chlorine, or strong nitromuriatic acid (in which chlorine is evolved), which may be made in an instant by mixing together equal parts of nitric and muriatic acids. These act by *decomposing*, and thus effectually *destroying* the poison, while, by absorption, the liquid will penetrate into the recesses of the wound. It was in this way that I operated on the wounds of a person severely bitten by a mad dog many years ago. This person in consequence, suffered no harm, though he was wounded in the act of separating a dog from the one which was mad, and inflicted the injury. This other dog became subsequently rabid—a full proof that the virulence of the disease was at its *maximum.*

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* Celsus makes the following remark, which may be adduced in corroboration:—"Ergo quisquis, exemplum Psylli secutus, id vulnus exsuxerit, et ipse tutus erit, et tutum hominem prestabit."

I quote the following from the '*Athenæum*' of 26th January last:—

"An American physician is said to have discovered that a few drops of any mineral acid applied to the bite of a rabid animal, will prevent hydrophobia. The acid *decomposes* the poisonous saliva, and cannot be injurious." This announcement had previously run the round of the newspapers for several weeks, and it will be perceived that it is only the *crambe repetita* of my experiment and recommendation.

I have experimentally found that chlorine, or nitromuriatic acid, which evolves it, is a complete antidote to the poison of the "adder" *(coluber berus,)* as well as the wild bushman's poison of Africa. Among other vegetable poisons, I also discovered that the same agent is a counter poison to hydrocyanic or prussic acid, also to the effects of opium, even when *coma*, &c., had supervened.

Guided by these more than mere analogies, and believing that in decided hydrophobia the entire system is inoculated, I would surround the body with nascent chlorine, by means of a case of Macintosh's air-proof cloth. I would also impregnate the atmosphere breathed by the patient with chlorine, evolved in the vicinity from the ingredients used in its obtainment (peroxyde of manganese and muriatic acid). As for auxiliary remedies, I leave that question entirely with the medical practitioner, merely stipulating that a temporary quietus, alone, can reasonably be expected by injections of tobacco. The method now recommended I adopted successfully in the case of the rabid dog.

Taking it for granted that there is a *specific poison* in this case, the following simple experiment will determine the question. Let a portion of linen rag be moistened with the frothy matter ejected by the rabid dog, and parted into eight pieces; finally, let one-half this number be exposed to the agency of Chlorine, and let so many healthy dogs be inoculated with them,—if those that have been exposed to the influence of the gas, be inert; while the others are followed by rabid symptoms, the discovery of a specific remedy in *Chlorine* is complete.

The following experiments are particularly interesting, as at once showing the power of Chlorine and announcing an effectual antidote to that tremendous poison, *Hydrocyanic* or *Prussic Acid*. Three or four drops of this acid would have instantly destroyed a large dog, and two drops were sufficient to destroy a cat. A stream of Chlorine was passed through *ten drops* of Prussic Acid; this was administered to a healthy dog, but it was followed by *no visible effect whatever*. Twenty drops more (sufficient to destroy five dogs) of the Hydrocyanic Acid were mixed with about an ounce of solution of Chloride of Lime, and given to *the same dog*. This being insufficient to neutralize the poison, the poor animal exhibited the most frightful effects of the acid. Solution of the Chloride being plentifully and continually supplied, the animal *completely recovered*, and has continued quite well. So that it is proved, beyond all doubt, that Chlorine, or even, Solution of Chloride of Lime, is a most complete and specific antidote for this formidable poison.

As connected with Dr. Carmichael Smyth's very interesting application of *nitrous acid gas*, as a disinfecting agent, I may here remark, that it seems to be introduced by a prospective Providence, for this *very purpose*, in every THUNDERSTORM. The Honourable Henry Cavendish, having transmitted a continuous series of electric sparks through a glass globe, containing a volume of atmospheric air, soon obtained unequivocal evidence of the formation of *nitrous acid gas* in the *red* vapour which arose ; it is interesting to learn that the constituent principles of the atmosphere are also those of nitrous acid gas, and that it simply requires a *reversal* of the proportionals. Now, *Electricity*, developed by artificial means, is merely LIGHTNING, though on a minor scale. I have invariably found distinct traces of this *acid*, in the rain precipitated in the thunderstorm, through the medium of Tincture of Logwood, which I find a very sensible test. Positive electricity superinduces acidity ; and this explains the tendency of beer to become acid, during the prevalence of thunderstorms. NITROUS ACID GAS is developed by the action of sulphuric acid on NITRE, placed on a heated plate ; and its efficiency may be proved, analogically, by passing up into an inverted cylinder, containing sulphuretted hydrogene, a slip of paper, previously dipped into nitrous or nitric acid, when decomposition will instantly ensue, as indicated by the deposition of yellow fumes of *sulphur*. This effect, however, is more energetic and determinate in the case of *chlorine*.

It may suffice now that I advert to the efficacy of nascent CHLORINE in the case of PLAGUE. Towards the commencement of the year 1801, the Plague, being an import from the Levant, raged with terrific violence in Andalusia, and was rapidly depopulating one of the fairest provinces of Spain ; in proof indeed, of its direful malignity, it may be mentioned, that the commissary Sarrais, an eminent Spanish physician, was seized on the very day of his arrival from Madrid, and died the following morning.—More than 10,000 had fallen victims to the destroying angel, when an old personal acquaintance of my own, and the friend of Guiton de Morveau, stepped forward like an angel of Providence ; as if commissioned to say to the destroyer, 'put up the sword into its sheath, for it is enough.' Senor di Gimbernat, just alluded to, carried into effective operation the disinfecting means employed and recommended by Morveau. THE PLAGUE WAS

STAYED; and these are the emphatic and memorable words used by Chevalier di Gimbernat to his friend, in his letter, dated from Seville, 18th January, 1801:—"The instructions which I communicated respecting the manner of performing the fumigations have produced the happiest effects in stopping the progress of the contagion in Andalusia. It is to the acid fumigations we owe the extinction of a malady which threatened to throw the whole nation into mourning." I have had the clearest evidence of the evolution of *nascent chlorine* on the sea shore, and the blanched sea-weed sometimes observed, indicates its agency.

Having referred to Sulphuretted Hydrogene as a fatal septic poison, and illustrating analogically the disinfecting power of chlorine, it may be stated that according to the experiments, instituted by M. M. Thenard, Dupuytren, and Chaussier, a greenfinch perished in a volume of atmospheric air, contaminated with only $\frac{1}{1500}$ part of this gas; a middle sized dog died in an atmosphere, containing $\frac{1}{800}$ part, and a horse in that with $\frac{1}{250}$. It proved fatal to a rabbit when applied externally to the surface of the skin, while the organs of respiration were entirely excluded from its influence. I have seen Baron Thenard withdraw a bird in a state of asphyxia, from the cause referred to, and bringing the beak in contact with chlorine, the bird recovered. It may also be added, that several persons that had fallen victims to the influence of sulphuretted hydrogene, in one of the public sewers at Paris, were recovered by the judicious administration of chlorine. When the cholera invaded Portobello, in Scotland, it was soon extinguished by nascent chlorine ; and I am informed by a physician of Shrewsbury, that this disease did not make its appearance in any form where chlorine was employed, though it was rife around. A variety of other interesting experiments might be referred to as illustrating the efficacy of chlorine in the destruction of poisonous and deadly gasses. When bubbles of Perphosphoretted hydrogene are passed up into chlorine, flashes of purple light superveue, and the gas is destroyed by decomposition. The experiment with *arsenicated hydrogene* is still more striking and beautiful : for the flashes of coloured light are accompanied with the deposition of metallic arsenic, forming a reflective film of considerable brilliancy.

Let it never be forgotten, that the agency of sulphuric acid on muriate of soda, *without* the admixture of Peroxyde of Manganese, or red lead, will *only* give rise to hydro-chloric or muriatic acid, an extremely irritating and a non-disinfecting gas. I, however, decidedly recommend, in preference, its more direct and immediate obtainment from the action of muriatic acid on the Peroxyde, by mixing the ingredients together. When we mix nitric and muriatic acids, the mingled acids assume an orange tint, and chlorine is formed. Chlorine may also be liberated from the Chloride of Lime or of Soda, by the addition of sulphuric acid—*heat* will, in these cases, render the evolution of the gas more complete.

If the hands be washed in aqueous solution of chlorine, it will obstinately adhere for several hours; —a fact of considerable consequence to the medical practitioner in attending on patients, labouring under infectious or contagious disease. This hint may be useful in the absence of the Preservative Phial; or, a *sponge*, saturated with the nascent gas, or its aqueous solution, might be carried in an air-tight bag, and opened when required. This, or the Phial, should be one of the traveller's accompaniments in traversing *malaria* districts. For the use of a family, where typhus or scarlet fever prevails, the following very simple method may be successfully adopted. To a tea-cup containing a small quantity of peroxyde of manganese, add, say a fluid ounce or more of muriatic acid, stir the ingredients with a rod, and place the cup and its contents in a soup plate containing water, about 'milk warm.' This can be put in some convenient angle, as that of the hall, or in the room of the patient.—If too powerfully felt, cover the cup with a flat plate, as of glass, or tile, and remove it from the basin, resuming it when required, and adding, when necessary, fresh portions of acid, or of oxyde.

No doubt the efficiency of chlorine, as a bleaching agent, depends on the decomposition of the water by the appropriation of its hydrogene, and the consequent formation of deutoxyde of hydrogene.

The late Dr. Henry proposed to *disinfect* bales of merchandise when in the Lazaretto, by employing a *high temperature* in the decomposition of the destructive miasmata. I cannot think, however, that any temperature short of what would injure the fibre as in the case of cotton wool, sufficient.* I would recommend CHLORINE COMBINED WITH STEAM, as completely effective—a stove heat being subsequently used; and thus the *duration* of quarantine might be materially and safely abridged.

That *chlorine* may be made extensively serviceable, as a medical agent, there can be no doubt. I have elsewhere recorded my sentiments on this subject, but may add, in reference to SCARLATINA; that having mentioned to a Gentleman at Clitheroe, the remarkable success that attended the use of it, adopted on my suggestion in a case of scarlet fever, he immediately verified it by reference to a case in his own family, and appealed for confirmation to his medical adviser, who happened to be present. A plate full of dry chloride of lime had been placed for the purpose of disinfection on the chair close to the bedside of one of his children, then labouring under scarlet fever. In the temporary absence of the nurse, the invalid had devoured a considerable portion of it. From that moment the amendment was rapid and complete. The internal exhibition of a weak solution of chlorine or a chloride, and sponging the body with it, seem to me to promise complete success as the means of cure.

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* I have been informed, that he found the variolid matter of small pox and of vaccine matter, inert on the constitution, after previous exposure to a temperature of 160° to 170° F.

Nurses and other attendants on, or visitants of, the invalid, in contagious or infectious disease, should, several times during the day, especially if handling the patient, as in small pox, wash the hands in a weak solution of chloride of lime. It becomes a subject of curious and interesting enquiry how far nascent chlorine in the room of the invalid, may modify or attenuate the malignity of the disease itself, as in typhus fever, scarlatina, and small pox. I apprehend it will be found to act very beneficially.

POSTSCRIPT.

In my brief commentary on the Pamphlet of Dr. Bowring, which I cannot but consider a dangerous and mischievous production, though certainly not so viewed by its estimable author, I repudiate all idea of presuming to question the *motives* of the writer; these are admitted without reserve to be above all doubt or suspicion. It is freely granted that Dr. Bowring's intentions are as pure and disinterested, as his motives are benevolent.

This notable pamphlet, many of the arguments, inferences, and assumptions of which have been anticipated and combated in preceding pages, seems to my simple sense, a strange and incongruous medley of inconsistencies and contradictions—a tissue of loose analogies and inconclusive reasoning. The part of his Itinerary which involves the question of the contagious nature of plague, had much better have been left *sub umbra:* even the editor of the "Lancet" says, that our author "has not attempted to write on the plague as a *medical* investigator; he does not affect to possess medical acquirements:" yet Dr. Bowring has certainly assumed the *medical* censorship, and dogmatized with the air of " one having authority." He and Maclean may dance a *pas de deux*, to the tune of noncontagion. I am not solitary in my opinion on Dr. B.'s pamphlet, for " his arguments and views" are pronounced by a competent judge, to be "loose and inconclusive."

His lucubrations, it appears, were well received by the medical section of the "British Association," at their last anniversary; but it is to be hoped that this favourable reception extended no farther than to the necessity of an inquiry into the phenomena of the plague, with a view to our quarantine regulations being founded on scientific principles, and thus to render their operation more certain and beneficial; but to abrogate quarantine laws altogether, which seems to be the drift and the legitimate tendency of Dr. Bowring's pamphlet, even on a remote possibility of plague being either contagious or infectious, and thus susceptible of transport, were a crime " to be punished by the judges," and one unparalleled in the annals of delinquency:—commerce may be dazzled by the glories of the golden vision which promises to replenish her treasury—and the lynx-eye of sober reason, and sound judgment, or solid understanding, be hoodwinked by a dorado in prospect, but the adventure is fraught with consequences the most perilous. This Moloch has devoured his millions—" will he make a compact with us?" will " we play with him as a bird?"

or rather, shall not "every one be cast down at the sight of him?"

Mr. A. T. Holroyd has come to the aid and relief of Dr. Bowring, in the form of a "letter" to Sir John Cam Hobhouse ; an evidence altogether very suspicious and questionable. His spleen, it appears, has been excited by the personal annoyance sustained in the operation of the quarantine laws. Is the health, therefore, of the community to be compromised, because an individual has suffered from, it may be, a capricious exercise of power on the part of the officials connected with lazarettos? There can be no doubt that a lamentable *abuse* exists, and that, too, to a very formidable extent, but the *abuse* of the principle does by no means destroy the principle itself. I, too, have been annoyed by the vexatious impost of quarantine, while I feel assured, that the immunity we have so long enjoyed from the absence of this impersonation of "the king of terrors," is undoubtedly attributable to our shield of protection—the quarantine laws.

The able editor of the "Spectator" has the following apposite and judicious remarks on the Brochure of Mr. Holroyd :—

"Mr. Holroyd appears to have been travelling in the Levant, and was delayed, annoyed, or inconvenienced by the quarantine regulations at Beyrout, Alexandria, and Malta. At the last two places he dubbed himself a Commissioner of Inquiry, and catechized the medical men (at least such medical men as were in favour of his views,) upon the subjects of quarantine and contagion. Their answers, together with his correspondence with the authorities, such facts as he could pick up, and his commentary on the whole, he has published in the shape of a letter to Sir John Cam Hobhouse.

"The substance is this. Plague is never absent from Egypt; but prevails most during the time when vegetable exhalations are rife. In the opinion of his informants, the pestilence is not contagious, but infectious—that is, mere *contact* will not cause it, but miasma or the effluvia from the infected will; and the seeds of disease may remain dormant from seven to fifteen days. The quarantine-regulations, if not altogether useless, are very often absurd, needlessly vexatious, and partially enforced. English Lords and Turkish Effendis being allowed to evade them, whilst humbler people must submit to the letter of the law."

After the vague and indefinite assertion of "millions of pounds sterling," as the estimated loss to commerce under the operation of quarantine laws, Dr. Bowring stigmatizes these laws and regulations as 'useless' for the end proposed, and assumes, that they even *increase* the evils they are designed to obviate.—He then proceeds to denounce them with a dogmatism but little in accordance with his previous *salvo* against entering the lists of controversy on the question of the contagious nature of plague, and tells us, he "soon discovered that the advocacy of its contagious character, emanated from individuals connected with the operation of the sanatory regulations of quarantine; and according to his estimate of the persons employed in lazarettos, they are either dishonest knaves or merciless tyrants.—Serious charges!—'*non nobis*,' *&c*—I must leave it as I find it. Another class of contagionists (he forgets Dr. Bulard!) is composed of individuals, who have not seen or studied the plague, which, of course, Dr. Bowring, albeit his lack of "medical acquirements," has done to his own satisfaction, and the edification of "those without."

Touching the contagious nature of plague, 'qui vult decipi, decipiatur,' Dr. Bowring is not one of the number. The plague, according to the 'discovery' of our author, is 'spontaneous, indigenous, endemic;' and whoever denied the position? In my reading on the subject, which has been tolerably extensive, I can find no one who ever defended an opposite opinion. This, however, has nothing to do with the communication of the disease by *contact*, or its transport in the human person, or as considered locked up in a bale of Levantine produce.

According to Dr. Bowring, the ignorant Levantines ascribe the occasional communication of plague to media the most absurd, kites and cats, mice (or rats) and mummies, fish and flies, dogs and monkeys; but though we may smile at their too easy credulity, and simple faith, the question remains precisely as it was. *Their* belief in ghosts and goblins, genii, peris and vampires, does not change the nature of truth into a lie, or affect the simple question whether plague be contagious or not. Dr. Bowring makes no distinction between contagion and infection, and by thus confounding them together, the reader is bewildered. Now, if it be *infectious*, whether contagious or not, the argumentation of the pamphlet is pointless, and the author is all the while combating a shadow. Clot Bey, Gaetano Bey, Mr. Abbot, Dr. Laidlaw, and others are the authorities, Dr. Bowring quotes on his side of the argument, and some of these are of the most equivocal kind. The evidence is mere matter of individual opinion, deduced it may be from imperfect observation, and incorrect reasoning, indeed Dr. Laidlaw expressly admits, in reference to the contagion of plague, that he "by no means denies it *in toto*." This wears, if it means anything, the livery of nonsense.—Plague is either contagious or not contagious ;—'to be' and 'not to be' are antagonisms, and can never synchronize. Rosenfeldt, it should be also remembered, a non-contagionist, *died* of the plague. Attention to the simple distinctions which I have eliminated in my pamphlet, will easily solve and account for some of the phenomena of the plague recorded by Dr. Bowring, such as the aggravation by endemic or local circumstances,—the attenuation or even extinction by change of place, as in the case of soldiers,—and thus the parched atmosphere of the arid desert may screen the pilgrim from attack. We find in the pamphlet before us some curious admissions, that peep occasionally through what may be called the 'loop holes' of the argument, such, *e. g.* as that "the plague has about it much that is unaccountable and seemingly capricious;" and that "the theory of specific contagion may possibly explain some of its influences."

"*Credulity*," says Dr. Bowring, "has divided all articles into two classes, the susceptible and non-susceptible of contagion." Notwithstanding this sneer, it is quite compatible with scientific observation and research, that these two classes may be sufficiently definite in their lines of demarcation.

Those that condense atmospheric moisture by radiation, and are absorbents, will be in a very different condition from such as are not; so that the distinction may be quite compatible with the canons of inductive truth.

The sum of the whole matter is this:—physicians, as well as others, fall victims to the plague, and these include, indiscriminately, contagionists as well as non-contagionists.—Among the former may be mentioned Lardoni, and in the latter class, Rigaud and Rosenfeldt. It is admitted that nearly a QUARTER OF A MILLION persons perished of the plague in Egypt, in 1834! Dr. Bowring concedes that during this period, in Egypt, opinions as to the contagious or non-contagious nature of plague, were nearly balanced.—The contending parties had both 'seen and studied' the plague, and suppose the balance even to remain *in equilibrio*, even on Dr. Bowring's own showing, it were more than madness to unchain this worse than Lernian Hydra. There is no Esculapian Hercules to subdue the monster. The tact and cunning of able physicians, who have devoted their lives to the task, in its stronghold, have been foiled,—and numbers have sealed their devotion by their death.

Unquestionably quarantines and lazarettos may be improved, nothing can be worse than the concentration and aggravation of the disease by numbers being congregated within a limited sphere. The space should be expanded to its utmost extent, consistent with the operation of the *cordon sanitàire* and the selected spot should be as free from endemic sources of aggravation, such as humidity and a stagnant atmosphere, as possible ;—dry air and free ventilation conjoined with the judicious use of chlorine may be most beneficial.

Dr. Bulard seems to advocate the establishment of a single lazarétto in a central position, as in the island of Malta, and the entire suppression of all the rest. I confess that I think TWO are necessary, to prevent the contingency of escape, and render 'assurance doubly sure'—so that in escaping Scylla the infected might fall into Charybdis.

I trust in my animadversions on Dr. Bowring's pamphlet, I have not been more severe than TRUTH warranted, and the paramount importance of the subject demanded. I should shudder at the responsibility entailed by the influence which such opinions might have on the public mind, my 'burden' is extremely painful, and I would have willingly been spared the ungracious task. A strong impulse of duty has impelled me to denounce what I conscientiously believe to be a most unguarded, and indiscreet tirade against sanatory laws, sanctioned, in the first instance by HEAVEN itself, and to the operation of which, on the soundest principles of INDUCTION, we owe our immunity from this destructive scourge for a happy period of nearly TWO CENTURIES. The ABUSE of the principle should be isolated from the principle itself, and salutary improvements on scientific principles is a very different question from an indiscriminate and reckless abrogation of quarantine, resulting from what in some instances, is mere metaphysical subtilty, in a question confessedly obscure, and which has more than any other exposed our ignorance, and baffled the art and science of man.

THE END.

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AMONG the various natural phænomena which more immediately belong to the physical condition of the globe, none are more sublime than the terrors of the sky in the thunder-storm. The echoes that sleep among the mountains roused from their slumbers, as soon as the "thunders utter their voices," perpetuate the peal among the hills and vallies, while the sound "waxes louder and louder," from its approach; but this dread note only proclaims to the ear of the philosopher, that the danger is past, though the announcement is terrible; and by the comparative rapidity of the succession of sounds, he can compute the distance, and the magnitude of danger. Composed amidst the war of contending elements, and the atmospherical battle scene, having studied the laws which direct the whirlwind, or impel the storm, and provided the shield of safety secured by those laws, he can command the obedience of this minister of destruction, and controul its power. Secure under their safeguard, he can watch the descent of the "forked bolt," and guide it to the ground, where it is at length quietly inurned.

The animal frame is by no means insensible to electric changes in the atmosphere. Some affected with weak sight, possess a premonitory feeling in the eyes, so as to predict a thunder storm a considerable time before its approach, and oculists on this account are careful not to perform any operation at such a period. Individuals are seized with head ache, &c. before the storm expends itself. When I retire to rest, electric flashes, sometimes intense and powerful, supervene on shutting the eyes, and pressing the ball of the eye by the cartilaginous ring of the cilia, or eye-lash; such facts shew how dependant the healthy functions of animal life are on the nice adjustment of atmospherical electricity. The inferior creation is also sensitive; while some animals cower and tremble, others utter a cry of fright and alarm, or give unequivocal indications that they are not unconcerned—instinct being the teacher, where intellect is denied. The chamois of the Alps,* feeding sometimes above the storm plane, trembles for its safety—cock pheasants crow at the close of each peal—the crocodile roars, and snakes and frogs hiss and croak.—Cold blooded animals, indeed, such as the frog, medicinal leech, and earthworm, are very sensible electroscopes. A correspondent in the Magazine of Natural History mentions his having received electric shocks from the larva of the *cerura vinula* or puss-moth found on a young poplar. The caterpillar evinced symptoms of irritation, contracting its body, and by degrees elevated and extended its bifurcated tail. "There were slowly protruded from out of the points bright red filaments, and irregularly bent to one side." Our observer felt a sudden tingle along his arms, and shortly after another shock, which forced him to cast the twig with the caterpillar to the ground.

---

* Marchietti, a celebrated chamois hunter, has observed that herds of chamois among the higher Alps, suddenly manifest great restlessness before the thunder-storm, however fine the weather may have previously been. The missel-thrush, called the "storm-cock," sings most and loudest previous to the approach of the thunder-storm, and it has been noticed by an observer, perched on a lofty elm, to sing without intermission during the continuance of the storm, while a cuckoo from an adjoining hedge repeated its note at short intervals; and at the distance of about 100 yards, a lark sprang up into the air and warbled its song in despite of the peals of thunder, the torrents of rain which fell at the same time, and the flashes of lightning which illuminated the sky. The latter I have indeed seen on the wing during the prevalence of the storm.

When the lightning darts from heaven to earth, no structure, whether of nature or of art, can withstand the shock. The Alpine aiguilles " pinnacled in cold sublimity," the tower, the monument, —" the gnarled and unweageable oak;"—all submit to its potency, tumble io the ground, or are shivered to fragments; and prostrate in the dust, are the symbols and trophies of its subduing power.

This sublime feature of lightning, is, however, only one manifestation of its character,—it is subtile in a softer sense. It steals through all the avenues and recesses of nature, pervades insensibly every department of the physical world, and is not less important in the stillness of its operations, than when it discharges its meteoric rockets amidst the lofty regions of the sky, and casts down showers of stones from the clouds. The animal, vegetable, and mineral kingdoms are controlled or modified by its influence, and are equally affected by its mysterious agency.

It may supply us with much matter of interesting thought, when we reflect that a power so dreadful, and so subtile in its ways and workings, should ever have been subjugated by intellect and reason, or become a captive of their spell; and, from being a minister of destruction, be converted into the messenger of good.—Apparently capricious in its evolutions, it certainly for some time eluded the mighty grasp of mind, and remained untamed while it seemed untameable. At length **Franklin** arose, and like Prometheus on the summit of Elborus,

"Eripuit cælo fulmen,"

and taught the daring enterprise to man;—an experiment as bold as any that had ever entered the speculations of human philosophy. For the first time was the important truth manifest, that the Creator of the universe had certainly, by simple yet effective laws, " divided a way for the lightning of thunder;" and in this beautiful physical demonstration of the problem, supplied a new source of admiration and delight.

Of the identity of electricity, artificially excited, and that of the thunder-storm, there can be no rational doubt. The only difference between the two consists in the vast accumulation of the latter, but almost all the phænomena and effects of lightning may be imitated by electrical experiments; and such as cannot be so exemplified, may depend on the want of apparatus sufficiently powerful to elicit the requisite supply, or to treasure it up. It was not, however, until Dr. Franklin had raised his kite, and the experiments were made in the garden at Marly, that the identity of the two was established on a basis that the most subtile scepticism could never move. Before this epocha in its history, our conclusions deduced from strong and striking analogies, as to their identity, could be received only as suppositions. On the 8th October, 1830, a thunder-storm broke over Mount Atlas. The entire horizon seemed on fire, and the thunder continued to roll without any sensible intermission. A strong white light was seen to gleam on the summits of the poles of the pavilions in Algiers: the phænomenon continued for half an hour. The officers who paraded the ramparts felt their hair bristle up, and stand on end, and in some cases stars of electric light studded the extremity of each hair: when their hands were held up, similar lights appeared on the ends of their fingers. Those exposed to this influence were nervous, and experienced a sensation of great lassitude. A great part of the experiments I am in the habit of making by means of the electrical machine, I have successfully repeated with the electrical kite; nor was I ever disappointed in my expectations in any season or period of the day, when the weather was sufficiently dry. Indeed, whenever there appeared indications of a thunder-storm, I laid aside my experiments, being instructed from some daring attempts, that under such circumstances, there is considerable danger. On one occasion, I charged, by means of the electric kite, in a few seconds, what communicated, by means of a Leyden jar, a powerful shock to nearly 100 persons. Any argument to prove that these are one and the same, is altogether uncalled for, and as the electrical machine simply collects electricity, certainly does not create it, it must not be forgotten that in our common experiments, by means of electrical apparatus, the phænomena are neither more nor less than those of lightning—on a miniature scale it is true, but the fact is not the less certain, that in these very experiments, lightning is our play-thing; this being the case, the study of the laws of electricity enable us to account for the phænomena of lightning on its more magnificent scale in nature; and by the imposition of those laws we gain all the advantage secured by a subjugation of its power, and are enabled to direct its influence into the channel of good. The individual not conversant with electricity, is apt to fancy that some mysterious agency is connected with the glass cylinder or plate, or the paraphernalia of silk, cushions and amalgam, or the auxiliaries of brass rods and balls, and glass jars lined with tinfoil; but the practical electrician knows better, and is aware that they only afford him facilities for the accumulation of electricity, and its direction and application. The intervention of glass is not necessary; other means may be substituted with as powerful an effect. Not to specify the numerous and diversified media for this end, I may merely state, that I have seen some remarkable and powerful electrical phænomena in the manufactory of the clothier. When the cloth passed rapidly between the heated cylinders, the flashes of electricity ramified into luminous branches, and on the approach of the hand, darted to it from a distance of twelve inches, and rivalled the largest and most powerful plate machine with which I ever made experiments. Sir Frederick Henniker mentions the fact of a common white linen sheet being shaken on the surface of the desert having emitted flashes of electric fire.

That called in common parlance, *lightning*, is presented to us under diversified aspects, and in its effects is more or less intense. What is usually called *silent*, or sheet lightning, is altogether harmless, and appears to be discharged from one cloud to another. The phænomena as seen on the verge of the distant horizon, peculiarly characterise this description of lightning: the effect of those curious flashes among the snows and glaciers, and rocky pinnacles of the Alps, is at once beautiful and sublime, though the use here of the latter term rather impeaches Mr. Burke's notion. The Alps, indeed, sometimes present phænomena of an electric character, calculated to excite interest and admiration. In a letter dated from Bruneck, Tyrol, 14th November, 1831, we have the following description of a beautiful phænomenon:—"Soon after six o'clock, A.M. a broad stream of light suddenly descended from the centre of the firmament, nearly down to the ground, and was then drawn gradually up again to the middle of the sky, whence for several seconds it stretched itself out towards the N. in a long ray of light, which first appeared in a straight, and then changed to a wavy line; after this, it gathered itself into a luminous orb, resembling a white cloud, and remained stationary in the centre of the firmament for more than a quarter of an hour, when it disappeared with the break of day. The appearance was accompanied by so vivid a degree of illumination, that the smallest pebble in the road was readily distinguishable, and those who were abroad at the time were completely panic struck. The sky, instead of being muddy with vapour, as is customary at this season, and at this time in the morning, was clear and cloudless, and the air remarkably serene and tranquil. Between five and six o'clock, however, an unusual number of falling stars were observed in various parts of the heavens."*

It is of course only such lightning as darts from the sky on terrestrial objects that is the proper subject of fear or alarm, and this seems to be presented under three more immediately distinct forms;—a sudden flash and general illumination, extremely vivid and overpowering. In this there is no distinct form or definite appearance; sometimes the entire atmosphere seems wrapped in a pale bluish and dilute light, and objects put on the same aspect as when illuminated by the burning of sulphur in oxygen; sometimes the flashes appear to be almost continuous, and kept up by an incessant support of the source of their production. The flashes are generally sudden, bright, and dazzling; and are succeeded by a peal of thunder at intervals, more or less prolonged, and violent rain usually falls. Sometimes the lightning is purplish, and at other times reddish; the colours being either dependant on the comparative density of the atmosphere, or extraneous matter with which the electric power may be charged; just as the electricity produced by the electrical machine varies its colour and intensity in condensed or rarified air—hydrogen or carbonic acid gas; or, when the electric spark passes through the vapour of ether, ramifies over silver paper; or the electric explosion is passed through links of steel, or over balls of ivory, boxwood, or charcoal. The colour, therefore, of the lightning, supplies us with a test to determine its comparative destructive power.

* Athenæum.

The next feature of lightning is that of a zig-zag or arrowy form, when it quivers in the dark back ground, on the sable thunder cloud in the distant perspective. In heathen mythology, this phænomenon formed the symbol of Jupiter, and the eagle grasping the thunder-bolt pre-figured its power and vengeance. Here the lightning is presented under a distinct and geometric form, with angles more or less acute as it darts from heaven to earth. This presupposes a considerable accumulation of electric power, necessary to overcome the resistance interposed by the atmosphere, which resistance is demonstrated by the arrowy line. This defined line of light proves a concentration of energy, as in the preceding variety of lightning, it evinced a diffusion and consequent attenuation. Sometimes this may be seen to strike a terrestrial object in the distance, and is always formidable.

There is still another and more destructive variety of these electric phænomena, and by far the most alarming of them all; this is when it assumes the appearance of *fire-balls.** The motion of these is easily perceptible, and wherever they fall, they explode, and do much damage: sometimes they *run along the ground*, or rest momentarily on something which arrests their progress, and then burst like a shell. Sometimes, also, the separated fragments of the explosion individually burst, and extend the mischief. It is especially worthy of remark that the Hebrew Legislator, whose veracity as a historian is only equalled by the singular accuracy with which he describes scientific phænomena, expressly names a phænomenon of this kind as characteristic of one of the plagues entailed on the Land of the Pharaohs. "The Lord sent thunder and hail, and *the fire ran along upon the ground;* and the Lord rained hail upon the Land of Egypt; so there was hail, and fire mingled with hail."† On Friday after-noon, July 30, 1830, a fire-ball during a thunder-storm, darted into the river Foss, at York, opposite the ground occupied by Mr. P——, in Walmgate, with such tremendous force as to raise the water considerably above its level, and it continued to bubble up, as if boiling, for nearly 20 minutes. The following detail from the "Maidstone Journal," a few years ago, seems descriptive of this peculiar form of lightning.—"On Friday, about half-past one, P.M. the *Dart*, then passing through the water at about 13 miles an hour, and in the five-fathom channel, opposite Whitstable, running for Margate, was overtaken by a stiff squall from the west with heavy rain. Several claps of thunder had been previously heard. After the squall had lasted a few minutes and curled up the sea in a curious manner in patches, the denser part of the cloud seemed to settle down towards the vessel. Whilst noticing its proximity, first a very faint illuminating light waved over the starboard paddle-box, and immediately an appalling flash and burst took place about nine or ten feet from the deck, directly between, although a little higher than, the paddle-boxes. The noise of the explosion somewhat resembled the discharge of a large howitzer when close to the hearer, having in addition a hissing noise, like a Congreve rocket, yet of shorter duration. The form and appearance of the fire was that of a flash from a 12 or 14 inch mortar, as seen at night, accompanied by some 30 or 40 red sparks like those from red hot iron when struck on the anvil. The flash, spark, and hissing, seemed to go over the larboard paddle-box towards the sea. One of the seamen who was on the look-out near the head of the vessel was thrown forward, bent, as he expressed it, to the deck. Two others near him received violent blows on the legs: luckily the rain had driven all the passengers from the fore-deck, either into the cabins or under the awning of the aft-deck." Last year, also, a small luminous electric ball of a similar kind, fell on the rusty iron conductor attached to one of the church spires of Wakefield. My informant tells me it occupied nearly three minutes in completing its descent,—a phænomenon in perfect conformity with these extraordinary electric configurations. In the circular flash of lightning the sound from every point, arriving at the ear almost simultaneously, will produce a stunning noise or crash,—sometimes a triple explosion is heard. In the rectilinear flash which may pervade a space, say of four miles in length, the sound proceeding from the nearest point will be the loudest, declining in intensity as the points recede in the distance, occuping altogether a period of 20 seconds. If the flash be ziz-zag, or composed of broken lines (the most common appearance it assumes), or if the principal trunk ramifies into branches and each becomes a separate source of thunder, we have all the varieties of that fearful and solemn sound accounted for.

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* In Abercromby Place, Edinburgh, a fire-ball last season seems to have descended a chimney and produced a considerable explosion, though providentially without doing injury to any one. This is the *second* visitation of the same kind, in the *same* place: proof sufficient of the liability of those spots which have been once struck, and should impart an impressive hint to provide for their future security.

† Exodus, chap. ix. v. 23.

The various modifications of the clouds depend, there can be no doubt whatever, on electrical principles, and their rise and fall in the atmosphere are determined by the attractive influence of the earth; and though the unseen mercurial threads of Linus are sufficiently fanciful and hypothetical, this invisible communication between the earth and the heavens may be said to be the tackling by which the clouds are depressed or raised to lower or higher stations in the atmosphere. I shall elsewhere describe, from Spix and Martius, the phænomena of the heavens which usher in, as its pioneer, the conflict of the aërial elements, and may therefore confine myself entirely to the appearances which portend the storm in these latitudes.

The commencement of the thunder-storm is indicated by the sudden accumulation in the distant horizon of a dark and ominous cloud formed by the coalescence of the cumuli which are observed to float through the regions of the atmosphere;—or, the cloud swells in magnitude on a horizontal plane without any visible cause, though the floating cumuli are seen to fall into, and be swallowed up in its vortex. The cloud whose structure has thus been reared in the air, rests on a base perfectly linear and parallel with the plane of the horizon. This base is sable and sullen, and the superstructure is composed of a series of arched clouds, tolerably well defined in their general outline, and of different degrees of shade. Sometimes there are two or more of these linear and sable planes. The whole remains for a time stationary, the winds are hushed into an unnatural calm, and the temperature of the atmosphere undergoes a remarkable change. In the meantime the cloud leaves its station in the sky, and is put in motion. The rains fall, and the lightnings flash, and the winds sometimes mingle their voices with the roar of the thunder. Again the plane of the storm-cloud becomes ragged and uneven; the well defined line no longer appears, and long narrow strips depend from the lower surface, and appear to connect together the earth and the sky. The discharges of lightning seem at length to affect the homogeneity of the thunder-cloud, which becomes less and less dense, separates into parts, and finally dissolves, or melts into " air, thin air," unfolding to the eye of the spectator a sky without a cloud—serene and beautiful. Such are nearly the phænomena which attend the termination of the tempest in the western hemisphere. " At length a change takes place, and the storm which lately raged so furiously, is over. The sun shines forth with renovated splendor through long extended masses of clouds, which gradually disperse toward the horizon on the north and south, assuming as in the morning, light vapoury forms, and hemming the azure basis of the firmament. A smiling deep blue sky now gladdens the earth, and the horrors of the past are speedily forgotten. In an hour no trace of the storm is visible; the plants, dried by the warm sunbeams, rear their heads with renewed freshness, and the different kinds of animals obey, as before, their respective instincts and propensities."

In the summer of 1818, I encountered a violent thunder-storm on the plains of Lombardy, and I advert to it, because the sky, previous to the tempest, had assumed a most extraordinary appearance:—as far as the eye could reach, it was clothed with an ash-colored cloud, singularly pouched or bagged, as if it were puckered or tucked up by some attachment, so that the immense plane seemed composed of huge vesicles. The storm overtook me as I walked from Como to Milan. The peals of thunder were dreadful, and the lightnings frequent and intensely vivid. The rain fell in torrents, or rather one descending sheet, and the fields and the roads were soon inundated. I found temporary shelter in a hut which the floods had subsequently nearly swept away. In countries within the tropics, or in lower latitudes, the lightnings are much more awful in their character than in this country. A gentleman once informed me that he had seen the thunder-cloud apparently rent in twain, and discover as it were an immense orb of lightning which seemed to burst, and shoot its arrowy shafts as from a centre, in every direction of the heavens.

The influence of the thunder-storm is usually of a limited extent, but not universally. The storm of the 30th of July, 1830, extended from Wolverhampton to Glasgow and Fife; and was said also to have embraced a part of Ireland. The simultaneous formation of storm-clouds in different parts of the heavens, and at remote distances, is not the least wonderful of these remarkable phænomena. On the 5th June, 1784, a set of electric balls, rung with electricity, when the clouds were elevated, and no indication of rain, while a violent thunder-storm attended by a considerable fall of destructive hail, took place about 50 miles distant. That thunder-storms have an occasional extensive range, may be also inferred from the following circumstances. On the 7th October, 1831, Henry Baker was killed under an oak at Burton-on-Trent, three others were rendered for a time insensible, and one dangerously ill. On Friday after, five calves belonging to an individual near Bridgnorth, were killed under an oak, and on the same day, near Hereford, an oak was struck, the weight of which was four tons. The entire trunk and branches were rent, and scattered in all directions, in pieces about the size of a lath, and one piece about eleven feet long, was carried a distance of 20 feet. Even in the individual discharge which takes place from the storm-cloud, a very considerable range is occupied in some cases; this, however, in all probability, must be ascribed to the continuity being dislocated, and its compact and homogeneous form, divided into branches by conducting materials scattered over the space on which its shaft alights, and its powers or intensity will of course be attenuated in the ratio of that diffusion. On the 30th day of June, 1821, the lightning struck the State Prison at Charleston, Massachussetts, and extended its influence over a considerable area. All the officers, convicts, &c. were more or less affected. The prison had three conductors, 18 feet from each other, along all of which the lightning seems to have passed, but did no further damage than merely to displace a few tiles from the roof adjoining. Nearly 300 officers, convicts, &c. were affected by the lightning, but none were injured. All of them appear to have had some description of metallic instrument in their hands, such as hammers, muskets, &c. and adjoining the convict yard was an armoury supplied with 30 guns, a similar number of pikes, &c. Individuals standing 500 feet apart were equally affected. One of the officers who was using a saw, observed it as if encompassed with "light red fire." The effects of the lightning were felt over a surface of 172,000 feet, and in nearly the same degree.

CHAP. II.

The Thunder-storm in both hemispheres—Accompaniments of the storm—Hail-stones—Effects of Lightning—Fulgurites.

Before the hurricanes in the East Indies come on, there is a dead and ominous calm,—the winds are hushed to sullen repose. This dread pause continues for about ten minutes. The kites and vultures scream and are terrified. The hurricane, like a giant refreshed by sleep, rises on the blast, and nothing can withstand the terrific fury of the embattled elements in which earth, sea, and air seem to contend together for the mastery. Trees are plucked up by the root, and the roofs of houses torn off and whirled into the air. This resistless violence continues about the space of an hour.

The sheet lightning is that most frequently seen in India. It exhibits a bright purplish light, repeated at intervals of about a minute, illuminating the entire hemisphere with a painful brilliancy, and leaving the sky shrouded in tenfold darkness, as if "it taught light to counterfeit a gloom." Mr. Elpinstone has given a graphic description of the storms that prevail during the monsoons, when the waters of the Ganges overflow their banks, and inundate the plains of Hindostan.

Spix and Martius, in their interesting work on the Brazils, have supplied us with the phænomena of the thunder-storm in the New World.—"The clouds are lowering; they divide into strata, and gradually getting heavier, denser, and darker, at last veil the horizon in a bluish grey mist. Towards the zenith, they tower up in bright broad spreading masses, and assume the appearance of gigantic mountains in the air. All at once the sky is completely overcast, excepting that a few spots of deep blue still appear through the clouds. The sun is hid, but the heat of the atmosphere is more oppressive. The noontide is past; a cheerless melancholy gloom hangs heavily over nature—the temperature is already lowered; the fierce and clashing gales tear up trees by the roots. Dark and foaming billows swell the surface of the deeply agitated sea. The roar of the river is surpassed by the sound of the wind, and the waters seem to flow silently into the ocean. There the storm rages. Twice—thrice—flashes of pale blue lightning traverse the clouds in rapid succession:—as often does the thunder roll in loud and prolonged claps through the firmament. Drops of rain fall. The plants begin to recover their natural freshness; it thunders again, and the thunder is followed, not by rain, but by torrents, which flow down from the convulsed sky. The forest groans; the whizzing rustle of the waving leaves becomes a hollow murmuring sound, which at length resembles the distant roll of muffled drums. Flowers are scattered to and fro,—leaves are stripped from the boughs,—branches are torn from the stems, and massy trees are overthrown. The terrors of this eventful hour fall heavily even on the animal world. The feathered inhabitants of the woods are struck dumb, and flutter about in dismay on the ground; myriads of insects seek shelter under leaves and trunks of trees. The wild Mammalia are tamed, and suspend their work of war and carnage."

Chateaubriand has, in like manner, very accurately delineated a thunder-storm in the western hemisphere, and as it gives us a faithful portrait of the same meteoric phænomena, it may appropriately follow what I have quoted from the work of the Bavarian Naturalists. " Clouds begin to spring up from the north-western horizon, slowly rising in the sky. The sun becomes overcast—the first muttering of the thunder is heard—the crocodiles reply to it with a hollow roar, as one thunder-peal answers another. An immense column of clouds extends from north-east to south-east: the rest of the sky is of a dirty copper colour, semi-transparent, and tinged with the lightning. The wilderness, illumined by a false day—the storm suspended over our heads, and ready to burst, present a scene replete with grandeur. The tempest commences. Figure to yourself a deluge of fire, without wind and without water. The smell of sulphur fills the atmosphere—nature is lighted as by the flames of a conflagration. Now the cataracts of the abyss open; the drops of rain are not separate—a sheet of water unites the clouds and the earth. These storms frequently set fire to the forests; they continue to burn till the conflagration is stopped by the current of some river. These burnt forests are converted into lakes and marshes. The Curlews, whose voice we hear in the atmosphere amidst the rain and the thunder, announce the conclusion of the storm. The wind rends the clouds, which fly shattered across the heavens; the thunder and lightning, attached to their flank, follow them—the air becomes cool and sonorous;—no relic of the deluge is left but the drops of water which fall in pearls from the foliage of the trees."

Dr. Boyle gives a lively and correct account of the African Tornado as it rages at Sierra Leone. " Its approach is first discernible by the appearance of a small clear silvery speck at a high altitude in the heavenly expanse, which increases and descends towards the horizon with a gradual and slow, but visible motion. In its descent it becomes circumscribed by a dark ray, which extends itself on every side, and as soon as the silvery cloud approaches the horizon, veils it in an impenetrable gloom." The system now feels an excessive oppression, and becomes as it were paralysed. The vitality of nature seems suspended, and the " dread note of preparation" is heard in the distant thunder. The aerial artillery waxes " louder and louder;"—the whole heavens are wrapped in one electric blaze of lightning, and the peals of thunder become at length terrific and appalling,—while from the " blackness of darkness" which shrouds the firmament, a mighty wind rushes, and overwhelms every thing in its resistless impetuosity. Meanwhile sheets of water descend from the sky, and inundate and devastate the country. The Kamsin, or " wind of fifty days," it appears is attended with electrical phænomena, and no doubt the moving columns of sand which sometimes traverse the desert, owe their origin to a cause rooted in atmospherical electricity. The Schirocco of the shores of the Mediterranean, and the Typhon of the China seas, are doubtless more or less dependent on the same agency. The tempest which accompanies the thunder-storm in South America, is thus described by Temple in his Travels in Peru.*—" The night is dark as Erebus, and one might fancy that the ocean had changed places with the skies, and was rushing down impetuously to take possession of its natural position. In the utter obscurity of the night, you cannot suppose that the deluge which pours and roars around you, can proceed from any thing else than the ocean itself turned topsy-turvy."

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[*] Vol i. p. 24.

In tropical countries, the phænomena of the storm, compared with their counterparts in these higher latitudes, are truly terrible, and though the thunder-storm is sometimes even among ourselves, formidable and full of alarm, it sinks in the comparison, into absolute insignificance.

Among the accompaniments of the thunder-storm, and which indeed may be considered an accidental effect of the electricity of the storm-cloud, I may mention the phænomena of *hail;* the production or formation of which, though the subject of much ingenious speculation, and a question which has exercised the genius and talent of the Natural Philosopher, does not appear to me one of much difficulty. Every electrician must feel persuaded that one obvious character of electricity is its property of dilating or expanding bodies; hence a drop of ether expanded by the electric spark, propels a ball with considerable force; moist clay expands and bursts, and a piece of wood is shivered to fragments. The natural effect of such an expansive force on a portion of moist atmospheric air under its influence, would be the production of intense cold, the consequence of a sudden rarefaction; and instant congelation, under such circumstances, would take place. The tunicated form of some hailstones proves an alliance with those numerous concentric circles formed by electricity, and communicated to a cake of resin by means of an electrified point, against which there has been subsequently projected a resinous powder, agreeable to the curious experiments of Professor Lichtenberg,—a phenomenon too which I have observed on the inner surface of a globular " shew bottle," placed in the window of a druggist. The liquid was tinged with cochineal, to which, I was informed, alum and acetous acid had been added. This curious and permanent impress appears to have been effected by the solar ray acting on the colouring matter, and precipitating it on the surface farthest removed from the window. In corroboration of this view of the formation of hail, it may be added, that if air previously condensed, be suffered to rush suddenly from its reservoir, a small portion of water contained in a thin glass ball placed in the current, will be immediately frozen, a phenomenon exemplified on a grand scale in the instance of the celebrated mine of Chemnitz, in Hungary, where the air, blended with water, rushing out suddenly, falls in a shower of snow.

Some of the hail-storms which have been recorded are of a most formidable character, and the hailstones in many instances of a most incredible magnitude. On 4th January, 1829, hailstones fell at Edmonton, near London, of an irregular form, some measuring three and four inches in circumference. In the years 1799, 1800, and 1801, many families in France were reduced to ruin by the destructive effects of hailstones on their vine and olive yards, and corn fields. In the Mysore country, towards the close of Tippoo Sultan's reign, a mass of ice fell near Seringapatam, of the size of an "elephant." This fact is recorded and well authenticated, and the late Colonel Mark Wilks informed me in the presence of Mr. Anthony Dunlop, at his residence in the Isle of Man, that he investigated the circumstance on the spot, where it was authenticated by the independent testimony of many individuals then alive, and who distinctly remembered the extraordinary occurrence. After deducting as much for Oriental fancy as we properly can, there still remains enough for special wonder. Hail-storms are by no means such rare phænomena in tropical countries as has been supposed. Dr. A. T. Christie mentions a violent hail-storm which occurred during his residence at Hyderabad, in May 1823, when the quantity collected was sufficient to cool the wine of a military mess for several days; and another at Darwar, about June 1825, where the hailstones are represented as having a white porous nucleus, and varying from the size of a filbert to that of a pigeon's egg. Lieutenant-Colonel Bowler, of the Madras army, witnessed a hail-storm at Trichinopoly, in 1805, in which the hailstones were as large as walnuts. Indeed masses of ice, or hailstones of considerable size have, at different times, fallen in Asia, from the clouds, and the details come to us so well authenticated as to leave no doubt of their accuracy. Dr. Halls mentions a storm of hail in Lancashire, &c., in 1697, on the 29th April, that for 60 miles in length, and two in breadth, destroyed trees, and even killed birds, and knocked down men and horses. A storm of hail fell near Liverpool in 1795, which almost destroyed vegetation, and the fracture of glass was very considerable; many of the hailstones measured five inches in circumference. In the year 1510, there prevailed in Italy a darkness deeper than midnight, succeeded by a storm of thunder, lightning, and hail, which is represented to have destroyed all the birds and beasts, and even the fish of the lakes and rivers. The storm was accompanied with a sulphureous smell; the stones which fell were of a bluish colour, and some of them weighed one hundred-weight. I shall add to the preceding remarks, the details of a few hailstorms of the present century. There was a terrific shower of hail at Monte Video on the 17th October, 1824, which continued about 15 minutes. The stones which fell are described as of the size of goose eggs, and some even larger. Several weighed three pounds each, three hours after their fall. This fall of hail was accompanied by a violent thunder-storm, and all the windows were smashed to pieces. A friend who was at Venice has supplied me with a note from his memoranda, of a destructive hailstorm witnessed by him in that city on the 23rd July, 1825. It was attended with thunder, lightning, and rain. It appears to have done considerable damage, and lasted 30 minutes. The hailstones were the size of hens' eggs, and the thermometer fell from 86 to 68 of Fahrenheit. The trees and crops in the garden of the Armenian Convent were almost totally destroyed, and the vineyard on an adjoining island presented, on the following day, a sad picture of desolation.

A thunder-storm occurred at Oporto on the 2nd April, 1830, at two o'clock, a. m. Great damage is stated to have been done to the windows and roofs of houses; and gardens. The hailstones which fell were as large as walnuts or pigeons' eggs. It appears from the *Aberdeen Chronicle* that a severe thunder-storm took place at Marnock, in Scotland, on Sunday, the 30th May, 1830. This storm was accompanied with a fall of hailstones or fragments of ice, which measured from four to five inches in circumference, and though it lasted only ten minutes, the hailstones were 15 inches deep on the ground, and took 30 hours to dissolve. On this occasion the destruction of glass was immense. One gentleman lost 2,000 square-feet of glass in his hothouses; in fact all the hothouses at Auchintoul House were completely destroyed. Vegetation also suffered severely—the cabbages were pierced as with grape shot, and the hailstones rebounded several feet from the surface of the earth. This thunder-storm was accompanied by a tornado; roofs were dismantled, and transported to a distance: and a " peat stack" was carried, at a great elevation, to the distance of 20 miles, and when in the air, as seen by a lady from her carriage, appeared like a dense phalanx of crows.

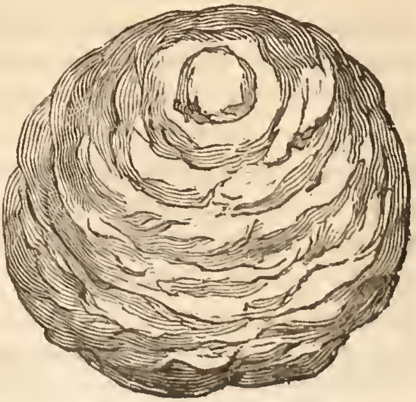
In the Duchy of Parma, a violent hurricane took place on the

17th June, 1831, on the eve of a rich and luxuriant harvest—an extent of country 30 miles long, and from 10 to 15 miles broad, presented a scene of the most complete devastation. All the hope and promise of the year were destroyed, and buried under heaps of hailstones, the smallest weighing half a pound, and the largest three pounds. The forms which these hailstones presented were various,—round, cylindrical, and square. The latter were from one to three inches thick, and two to eight inches broad. Thirty villages between San Dorino and Parma, were entirely ruined. The extent of the destruction was much increased by the inundation of the Taro and Parma. The detail in the *Parma Gazette* is full of horror.

Mr. W. Spence describes a hail-storm at Lausanne, on the 14th July, 1831. " A great proportion of the hailstones were as big as hens' eggs, and some even bigger: *seven* nearly filled a common dinner plate. They were mostly oval or globular, but one piece brought to us after the storm, was flat and square, full two inches long, as many broad, and three-quarters of an inch thick, with several projecting knobs of ice, as big as large hazel nuts. This mass exactly resembled a piece of uniformly transparent ice, but the oval and globular masses had the same conformation as has often been described in these hailstones, and on which Volta founded his ingenious but untenable theory of their formation. In the centre of each was a small white opaque nucleus, the size of a pea, and evidently one of the hailstones usually seen in England, to which the French give the name of *grésil*, confining the term *grêle* to the larger masses of ice now under our observation. This nucleus of *grésil* was enclosed in a coat, about half an inch thick, of ice considerably more transparent than it, but still somewhat opaque, as though of snow melted and then frozen again, and externally the rest of the mass was of ice perfectly transparent, and as compact and hard as possible, resounding like a pebble, and not breaking when thrown on the floor. The inhabitants of Lausanne, aware that the cinerous and puffed up appearance of the clouds charged with this tremendous aërial artillery, portended more than a mere thunder-storm, had adopted the precaution of closing their Venetian shutters; but such windows as were deprived of this protection had almost every pane broken; and much damage was done to the tiles of all the houses, and to the gardens and vineyards." This storm lasted only seven or eight minutes. A thunder-storm occurred in Silesia on the 16th August, 1832. Accounts state its having almost entirely destroyed thirteen villages. Some of the hailstones were nearly one pound weight; and though the continuance of the storm did not exceed a quarter of an hour, the hailstones were half a yard deep.

A hail-storm occurred at Constantinople, on the 5th October, 1831. About six o'clock, a. m., threatening clouds rose in the distant horizon, to the south-west; and after sounds altogether peculiar, being neither those of the tempest or of thunder, lumps of ice began to fall, first singly, and in size as large as a man's foot. This was succeeded by a thick shower of hailstones which seem to have destroyed every thing they came in contact with. Some of those picked up half an hour afterwards, weighed nearly a pound, and were 14 inches in circumference. This storm passed over Constantinople and along the course of the Bosphorus, over Therapia, Bajukdere, and Belgrade; and the fairest and only hope of this beautiful and fertile tract (the vintage just commenced) was destroyed. Animals of all kinds, and some persons are stated to have been killed, an innumerable quantity wounded, and the damage done to the houses incalculable. It was added, that scarcely a window in all the country had escaped. The force of the falling masses of ice was so great that they broke to atoms all the tiles on the roofs, and shattered like musket-balls, planks half an inch thick. The rain for several subsequent days continued to descend in torrents. The form of the hailstones were various; some tunicated like an onion, others irregularly quadrangular, &c.

The annexed figure, copied from one of the tunicated hailstones, represents its correct form and natural size.



In February, 1750, a violent shock of an earthquake seems to have been felt in London, accompanied with tempests of thunder, lightning, the Aurora Borealis, rain, and hail. It was repeated on the same day of the following month, between five and six o'clock, a. m. " The shock was preceded by low flashes of lightning, and a rumbling noise, like that of a heavy carriage rolling over a hollow pavement. Its vibrations shook every house from top to bottom, and in many places the bells were heard to strike."* In August, 1763, a storm of lightning, rain, and hail, occurred in London and adjacent parts, and did damage to the amount of 50,000l. Hailstones fell from two to ten inches in circumference. There was a sudden flux and reflux of the tide at Plymouth, similar to that which took place there at the period of the great earthquake at Lisbon. The consentaneous (if the term be permitted) occurrence of earthquakes and volcanic phænomena in distant regions, with tempests and storms, the rise and fall of tides and lakes, and the troubling of the waters of springs, &c. shew a mystical dependence on causes which, though obscure, must be common in their source, and connected by lines of communication, however remote the extremes may be. A thunder-storm took place near Brussels on the 20th of August, 1763. The storm was attended by vivid and intense lightning,—the roofs of houses were forthwith dismantled, upwards of 1000 large trees torn up by the roots or broken off close by the ground, and some transported to a distance of more than 100 paces. Entire coppices were laid on one side like corn prostrated by an ordinary wind. Such windows as were exposed were shivered to pieces, and a tent transported from a garden to a distance of 4000 paces. On 9th October, 1803, a tremendous thunder-storm occurred in Madeira. Rain fell in sheets or immense torrents. The rivers overflowed their banks, and with an impetuous and overwhelming torrent swept away entire vineyards, and other plantations, with cattle, wine stores, and the huts of the inhabitants, who with their whole families perished. Stores of immense magnitude, as well as the largest trees, torn up by the roots, were carried down by the inundation from the mountains to the channel of the sea. " The greatest havoc and devastation occasioned by the rains was in

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* Valpy's Divines of the Church of England.

Funchal. Here, as in the twinkling of an eye, whole streets of houses, with their inhabitants, were swept into the ocean. Churches, bridges, and edifices of every description, were involved in the general wreck, leaving hardly a stone or other vestige behind them to be discovered on the following morning, when the storm abated." It is computed that 300 persons perished. The monsoons of the East, and hurricanes of the West Indies, are so many additional examples of the " signs and wonders of the firmament."

The effects of lightning are as wonderful as is the power of the assailant. Though lofty edifices be sometimes the subjects of its assault, lower structures, and trees, &c. but little elevated above the plain, are singled out, and become its victims.* Some conducting point either in the objects struck, or in the soil or substrata, has determined the course of the lightning, for its direction is guided and governed by laws.

" There is," says Captain Tuckey in his Narrative, "a singular pyramidal stone, (a natural block of loose granite, with another perched upon it,) which rises out of the circular summit of a hill. It is called *Enzazzi*, or the lightning-stone, and is held in veneration." The cause of this veneration may perhaps be found in its attraction for lightning, and the meteor may have been seen to fall upon or flicker around it. The pyramidal monument near Glasgow, reared to the memory of Nelson, was scarcely finished, when the lightning fell upon it and rent it in twain nearly from top to bottom; while the united testimonies of Rich, Buckingham, Sir R. K. Porter, and others, concur in ascribing to the effects of lightning, the rent of the Birs Nemroud, among the ruins of Babylon. This ruin seems to have been the tower of Babel, and subsequently the temple of Belus;—a conclusion legitimately established by Mr. Rich, and Mr. Buckingham, though in opposition to Mr. Mignan and Major Rennell. The very fact of its having been struck by lightning, might lead them to consecrate the spot to Baali, Baal, Bel, or Belus. It is interesting to observe that the Rabbi, Benjamin of Tudela, who lived about the year 1160, and who visited Syria and Palestine, alludes to it. " About 10 cubits of the winding ascent which formerly went up to the top in the same orbicular manner, are still remaining. From this tower you have a prospect of twenty miles round, for the country is very open and level; but the fire of heaven fell upon it and shattered the tower from the top to the very foundation."* Last summer the lightning struck the obelisk at Castle Howard, the seat of the Earl of Carlisle, and considerably injured it. I have a specimen of fused amphibole from the summit of Mont Blanc, which I cannot doubt was the effect of lightning.

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* On the 7th September, 1832, the lightning struck the wall of the parish stone-yard, in Richmond-street, Lisson Grove, and rent it to the foundation in an extent of nearly 90 feet. The wall, &c. fell with a tremendous crash, choked up the mouth of the tunnel, and overflowed the towing path to a considerable distance.

The effects of lightning are sometimes extremely curious and unaccountable. Among its more singular impressions may be mentioned those which blasted the attempt of the Jews, and the apostate Julian to rebuild the temple on Mount Moriah. The rash enterprise was just begun when an earthquake shook the Mountain to its centre. Flakes of fire broke forth, accompanied with fearful explosions. The iron tools of the workmen were melted, and impressions like crosses were left on the clothes of those engaged in the work. A crusade, denounced by Him who was " greater than the temple," was thus frustrated, promising though the auspices were, under which the adventure was begun, by the visible interposition of a divine hand. The accounts of the matter left us on record by Pagan writers are sufficient to shew a direct and immediate interference, and the *opus reticulatum* still remains to attest the fact, and stand in evidence of the miracle.

I have elsewhere given an account of the effects of a thunderstorm at Lichfield: the following, recorded in " Silliman's American Journal," is equally remarkable and curious:—"On the 3d June, 1826, during a heavy shower of rain, a clap of thunder burst, with tremendous explosion, over a house in Weathersfield, Connecticut. The lightning ran down the chimney to the ceiling of the front room, where it came through, leaving a hole nearly an inch in diameter—tore off the paper and plaster from the wall—descended on a row of nails in the laths to a picture—melted all the gilding—burned and tore one side of the frame—and, again rending its way, ran upon the nails to the fire-place, and separated the breast-work from the chimney; and from thence taking a horizontal direction, attracted by an umbrella in the corner of the cupboard, a small line was to be seen from a nail to a bolt in an opposite closet. From the umbrella it went off at an angle, and came out over the fire-place in a lower room, in *nine holes*, the largest the size of a common gimblet, scorching and slightly tearing the paper. It entered at the corner of a picture, melted the gilding, blackened the frame, and passing off at another corner, separated again into several lines, intersecting each other, until they centered in a nail in the shelf. It passed down the back of the moulding, tore away a hard cement below, threw forward a false back of brick and iron, split the floor on each side of the hearth, rent off splinters two feet in length from the under floor in the cellar, and went east and west through a stone wall into the earth. The greatest force was exerted in the chamber-closet. The point of the umbrella was brass, and just beneath the wire which connects the whalebone it was burnt off; and the silk, the stick, and the whalebone, were nearly consumed. Several folds in some woollen carpets were burnt. A fur muff, a cloth coat, and some other articles were also much injured; a sleeve and part of the waist of the coat were destroyed, while the *cotton lining* to which they were stitched was *left whole*, and excepting a small piece, was not even tender from scorching. A black sulphureous smoke arose from the spot, and filled the house. A lady was in the closet with the door shut, and but a foot distant from the course of the lightning. The sound was dreadful, like cannon at her ears, and the heat inexpressibly great, as if she were in the midst of flames. She spoke at first of intense light, but all consciousness of that has since passed from her mind. In this terrific and awful situation she was preserved unhurt, came out immediately and closed the door. It may be remarked that she was clothed *in cotton*, and a roll of carpeting stood between her and the umbrella. Five boards were thrown down, and four rooms were filled with the smell of sulphur, and covered with soot. The electrical fluid entered four closets adjoining the room in the lower story,—ran round china cups, plates, &c., raised and dissolved the gilding or converted it into the purple oxyde of gold, and, leaving a dark bluish path next to a nail, where it splintered the partition, escaped through the back of a door to a hinge. In a closet, without paint, it discoloured the wood three inches in width, broke four dishes, and drove out nine nails, four of them from a hinge; in a third it left an aperture, as large as a bullet-hole, in the ceiling, split the floor three feet, and tore up four inches, about an inch wide. In a fourth, it overturned, tossed out, and broke large phials of medicines, pill boxes, wafer-boxes, &c. drove four nails partly out of the hinges, and rent off a piece of the casement. On the top shelf lay several iron articles. It pierced the ceiling in the back room, came down in two branches, and so completely *dissipated four cents weighing about* 165 *grains*, which lay upon a nail in the moulding, that, except a metallic stain on the lead paint of the shelf, not a trace of them remained; they *appear to have flashed away like gunpowder.* In the chamber, eight feet from the chimney, it came out over the corner of a looking glass in three places, the largest like a gimblet-hole—split the back-board of the glass into three parts, melted the gilding, and went off at an opposite corner in one large place and *nine small ones,* through the wall to a window in the room beneath, splintered the casement by a nail into five or six small pieces, and killed a rose-bush which was tied to a nail on the outside of the house. Opposite, and fifteen feet from the chimney, hung a piece of embroidery; three small holes were left in the wall over one corner of it; two thirds of the top of the frame, which is of mahogany, is split up to a corner; where it appears as if the fluid ran down the back of the glass, to a basket wrought with gold thread, and, blackening it, passed off at another corner, through three small places in the wall, and came out in five points like nail marks in the ceiling over a looking glass in the first story, ran all over the gilding, and went off through the wall by the nails which support the glass. The paint in the chamber was turned of a very dark colour with a metallic cast: the paper was red and blue, the *red,* excepting near the floor, had entirely disappeared. There was no lightning-rod on the house."

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* Travels of Rabbi Benjamin, &c. London, 12mo. 1783, p. 106.

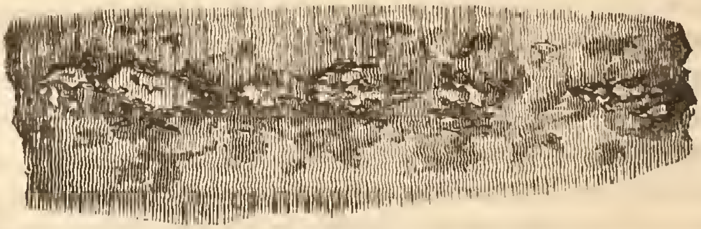
The preceding description of the effects of lightning is very interesting, and, conjoined with what I have detailed in another place, reads an instructive lesson to us. Here is ample evidence of the division of the meteor into various ramifications or streams, a curious selection of metallic materials and their fusion, oxydation, and vaporization, when insulated either partially or entirely, (being thus discontinuous conductors) wherever they stood in the way of its progress; and its leap to non-conducting substances which were destroyed, or fractured, or burnt up, together with the non-electric if in contact with them. It seems to me highly probable that the lightning, when it scorches or vaporizes, carries with it, part of the materials on which it has been occupied; and that its momentum is increased partly by the opposition it meets with in its progress to the earth, by the non-conducting media and materials that obstruct its path.

In 1828, the Catholic chapel at Wrexham, Denbighshire, which was newly erected, and had not yet been opened for public worship, was struck by lightning during a thunder-storm. I was immediately afterwards on the spot, and examined with some care the effects of the lightning. The meteor descended the chimney (which was still damp) in two branches. One of these passed down one flue to the ground floor;—this chimney place had as yet received no grate. The lightning perforated the brick and mortar at the angle, and pouncing on a spade inclined against it, the cross-piece at the top, fastened by a nail, was wrenched off, the shaft splintered, and part of the iron spade fused at the edge: from this spot it dashed through the window, which it shattered considerably. One of the inmates in the adjoining room on the ground floor received a violent electric shock, and was knocked down. The superior branch of the lightning after descending the flue to the grate on the first floor, left the impress of its power on the grate by an evidence of partial fusion on points and angles. From thence it darted to a partition wall separating the body of the chapel from the rest of the building, and with a surprising fierceness, tore up a considerable extent of lath and plaster, determined by the nails which fastened the former. The door was torn from its hinges;—from thence it seized on the hinges of the door which led to the altar; these hinges it tore from the railing to which they were attached, and entering the enclosure, appears to have ramified and diffused itself over the carpetting, singeing it here and there, in contact with the nails that fastened it to the ground, and many of them exhibited evident marks of having been fused. From hence the lightning seems to have been attracted to the iron curtain rod in an adjoining window. The window frame and glass were completely shattered, and the paint stained with the metallic oxyde of the iron rod. The gable of the building was rent by the lightning for a considerable extent downward. Mr. Lloyd, of Whittington, near Oswestry, informed me that some years ago his house was struck with lightning during a thunder-storm, about the middle of the ridge on the roof. The *lead was perforated with a minute hole.* It expended itself chiefly on the lath and plaster wall, which it demolished, and unlinked part of a iron chain. A dog in the kitchen howled, and no doubt received a shock, as did Mr. L.'s brother, who accompanied him into the kitchen immediately after.

During a tremendous thunder-storm at Huddersfield, on 13th July, 1831, two buildings, at some distance apart, and forming a triangle with St. Paul's new church, were struck. One of these was the house inhabited by Mr. Clough : the lightning appears to have been attracted by the iron clamps of the chimney, and, after hurling the stones about in all directions, some being projected to the distance of forty yards, it finally discharged its fury downwards in a shower of soot, of which some bushels were collected. It then darted through an opposite window in the kitchen, which it destroyed, determined by iron palisadoes without, and buried itself in the earth. A mass of these ponderous stones fell on the roof of some adjoining buildings, and forced their way through. These stones seem to have been shattered as by an explosive force from their interior, and I presume the phænomenon is most easily to be accounted for by the sudden expansion of absorbed moisture acted on by lightning. It cannot, I think, be doubted that this is the chief cause, though certainly not the only one, by which the Alpine rock is shivered in its eagle seat and hurled into the valley. It is however known that in winter the sudden expansion of the water of infiltration in the act of congelation, while it rends the glacier and launches the avalanche, also rifts the rock and disperses its fragments. I confess, however, that without taking into estimate this power of the electric meteor, it is difficult for me to account for those numerous fragments of rocks which are met with on the summits and acclivities of some mountains. They are angular, and have clearly been the ruin of mountainous masses shattered by some convulsive force or explosive power. The fall of the electric bolt is a circumstance which readily solves the problem of these phænomena, and without which it seems difficult, if not impossible, to account for them.

Diffused over an immense area they seem as if launched from the heavens, or scattered by the arm of a Titan. About three years ago several persons had taken shelter under an alcove, having an iron roof supported by stone pillars, during a thunder storm, near Malvern, Worcestershire. The lightning *at the same time struck a stone, which it shivered to fragments.* I have my information from an individual who instantly repaired to the spot after the accident.*

The house of Mr. John Lister, of the White Lion Inn, on a line with that of Mr. Clough, mentioned in the preceding paragraph, and forming with St. Paul's Church, the base of a scalene triangle, was struck at the same time, attracted by the several flues of a chimney. It entered several rooms, destroying every thing that chanced to be in its way, and was then conducted into other rooms by the bell wires, from which wires, in some places, the paint had scaled off, and hung in narrow strips; in other parts the bell-wire was fused, and even vaporized,—some melted portions had fallen on the floor. In the commercial room the vaporized bell-wire left on the wall an extensive stain of oxyde of copper where the bell-wire had previously been, and which had entirely disappeared. I had the following copied from the wall, from whence it will be perceived that the impression in the subjoined figure, is somewhat of a nebulous character.



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* The curious configurations of dust on the pavement similar to the figures assumed by one kind of electricity on a resinous cake, and rendered visible by the projection of a mixed powder against them, is entirely an electric phænomenon, explained first by the late Dr. James Miller, of Edinburgh; but there is still another which has been, if I mistake not, entirely overlooked, though in itself of sufficiently curious interest. I now allude to the semblance of *distinct foot marks* in the sand-stone flag stones. To this phænomenon I have paid considerable attention, and feel altogether persuaded that the laminæ scale off in consequence of the electricity excited by the footstep, its influence being communicated to the absorbed moisture which

I noticed in this room a very curious phænomenon. The hat pins of cast-iron ranged on opposite walls, which were fastened in a frame of wood, were *snapped off close by the wood*, as by a mechanical power; few were left, and these generally *alternate* ones. In this room, the electric matter had darted from the bell-wire to a brass candlestick on the mantel piece, and the candlestick was melted in parts, the wood-work which formed the chimney-piece and casing was wrenched from the wall, and much shattered. On examining the attic roof, I found that it was perforated, but from its diversified ramifications it was difficult to trace its main branch;—obeying no steady direction; wherever it found anything in the shape of a conductor, it seized on it with savage fury, and whatever non-conductor interfered with its progress it destroyed. Scarcely a room in the house appeared to have been unvisited by it;—in one room some chimney-piece ornaments of various kinds were destroyed, or tossed on the floor, and another candlestick partially melted. From this room it darted through the wall, perforating it as if bored by a very small gimblet, and entered the adjoining bed-room close by the edge of a picture in a broad gilt frame. On this gilding it seems to have fluttered, as if in playfulness, and had covered it almost all over with a curious cobweb-like tissue of purple threads—the purple oxyde of gold,—while the glass remained without the slightest evidence of fracture. It seems also to have visited in like manner the gilded mouldings of the bed, and consumed in an instant the wood shavings with which the grate was supplied.

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expands and throws off the superincumbent laminæ; and though these of necessity, from the inequality of pressure, must be irregular forms, yet the distinct print of the sole of the footstep may be frequently seen in all its true proportions and form. I have also observed the right and left foot marks of the same individual, and so distinctly characterized that there could be no mistake on the subject. It is the foot which causes those configurations of dust already adverted to, and this is merely another natural effect of the same cause. It is thus, I imagine, an easy matter to account for the foot marks on the summit of Adam's Peak, at Columbo, in Ceylon, and on the Mount of Olives, together with that of "Mahomet's Camel," near Sinai, so long the objects of veneration, of a degraded superstition. I take no note of the gigantic foot mark of Gaudma and its fringe of convoluted shells, now safely lodged in the British Museum; for eastern superstition has *modelled* as well as adored it.

The windows and the frame work of some of the rooms entered by the meteor were rent into splinters, and in most cases the glass shivered to fragments. In these remarkable peregrinations, it entered the kitchen, *cut the gas pipe in two, and having lighted the gas*,* ran along a range of pans, and other kitchen utensils, made its final escape through the window, and destroyed the square of glass through which it passed. It was singularly interesting to follow the manifestations of the presence of the destructive meteor in the traces it left behind : discriminating in its choice, it appears to have run about like a living thing in search of objects whereon to vent its fury. At one period the kitchen presented the appearance of an universal blaze of light,—and all these remarkable effects *were the work of a moment.* Two of the inmates were knocked down in one of the upper rooms, but none received permanent injury. During the same thunder-storm, the chimnies at the mansion of James Brooke, Esq., of Grove, were much damaged.

In the plate prefixed to this work, is the representation of a remarkable effect of lightning, produced on the wall of a house near Paris, on the 14th of February, 1809, by the fusion, and oxydation of iron bell-wire. The length consumed was about two feet, and the surface of the wall was covered with this curious impression of oxydation to an extent of about six feet in length, by four feet in breadth. A large print of the phænomenon was published in Paris, from which the appearance represented in the plate was copied. It is thus announced in the *Journal de Physique.*† " Le 14 Fevrier 1809, le Tonnerre tomba sur la maison de M. Badener, No. 2 à Antoine près Paris. La matiere fulminante volatilissa 8 decimètres de fil de fer de sonnettes, et laissa sur le mur une impreinte de près de 2 metres de longeur sur 1 metre 2 decimetres de largeur."

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* On Sunday evening, 10th March, 1833, during a severe thunder-storm in Belfast, a gentleman living in the south west part of the town had just extinguished his bed room candle as the thunder-storm burst over his house. Such was the intensity of the electric condition of the atmosphere at the moment that the candle was relighted, and a bluish flame continued to play through the room for some seconds.

† Vol. 61, p. 452.

In addition to the examples of the effects of lightning which I have cited, I may add a few of the more remarkable phænomena, the details of which have come under my notice. Among the eccentricities of lightning may be mentioned its singularity of destroying *alternate* objects, thus each alternate horse in a team has been killed by lightning, and the intermediate horses have escaped. This is generally accomplished by that description of lightning to which I have attached the name of fire balls, which sometimes separate into fragments. I remember a case some years ago, when several cattle were destroyed in a field in Essex, wherein, the lightning having destroyed a cow, appeared to have leaped on another at a short distance, which also became its victim. It is not improbable but the skin, being more or less moist from wet, would determine the selection, or the corresponding colour of the hair guide the progress of the meteor. During a thunderstorm, two individuals were engaged in conversation. One, whose dress had been previously wet with rain, escaped, after feeling a glow of heat, and receiving a shock; while the other, whose clothes were dry, was killed on the spot. In such a case there is no difficulty in accounting for the effect. The lightning would fall harmlessly on an extensive surface of a conducting character, and its power would be rendered inert from dilution and diffusion. Captain Johnstone, of Mainstone, near Hereford, communicated to me the following phænomena, which he witnessed in 1793, in Pembrokeshire, South Wales. The lightning having struck the steeple of a church, forced down the centre bell of a set of three bells, and taking the line of pews on the left side, its progress could easily be traced by the scorched appearance of the paint up and down the divisions of the pews, and the torn state of the seat cushions, until it arrived at the altar when it forced a *hole through the solid wall, (near a yard thick,) about the size of half a crown,* the orifice appeared blackened as if by gunpowder and smelled strongly of sulphur. When it had escaped into the churchyard, it shot across about 20 yards in a northern direction, and set a cart house on fire, without doing any further injury.

Some years ago the lightning fell on the shot tower at Derby; the shock I have been informed by a person who happened to be in the building at the time, shook it to its centre, and when it reached the ground by means of the imperfect conductor attached to the tower, the lightning *flew off at a tangent*, to a mass of fragments, of cast iron, and rung its peal on them.—No damage was sustained.

I have already adverted to the *red colour* selected on paper hangings, and this peculiar selection of colour is often equally remarkable in other cases. In the transactions of the Royal Society is a singular account of a pied bullock having been struck with lightning in Sussex, on the 28th of August, 1774. The peculiarity in this case was, that the lightning detached all the *white* hair, and left the red untouched. This animal finally recovered. The white hair however on the belly remained untouched. A similar phænomenon is on record in the case of another bullock, in which the small red spots on the sides remained unaffected, and the white in like manner under the belly and on the legs remained untouched.

It is stated in the *Glasgow Courier*, that on the 10th of July, 1830, a person named John Robertson employed on the road near Stewartown, became the victim of lightning. His shoes were torn to shreds, and the nails forced out. His watch was also broken to pieces with the exception of the *dial* which was found entire, 150 yards from the spot.

In August, 1830, the lightning entered the chimney of a hut near Chelmsford, Essex, and broke the blade of a sword attached to the walls, but did no further damage. About 3 years ago a female at Whitby was using a knitting needle, when a flash of lightning severed the needle into five pieces. Lightning struck the chain of the main sheet of the *Ariadne* of Whitby, Captain Naylor, while the vessel lay at anchor near Tilbury Fort, on the 14th of June, 1824: passing through the Cambouse on deck, it killed a cat, from thence it made its way, through a hammock, struck a bunch of marline spikes attached to a peg and knocked them down, and was afterwards extinguished in the sea, having passed through the bottom of the vessel. Several fragments of the shattered chain are in the museum at Whitby, but on examination I did not find that they had acquired permanent magnetism.

On the 11th of March, 1831, the lightning fell on a powder magazine at Port Alegra, about a league from Rio de Janeiro, and blew up 37,500 lbs. of gunpowder. It was felt in that city like the shock of an earthquake.

In the latter end of May, 1832, a girl was killed in Berkshire, by lightning, during a thunder-storm. She was using an umbrella at the time, and wore a steel busk. On the 3d of July, 1830, it is stated in the German papers, that a female, aged 40 years, was struck with lightning, it having been attracted by a tombac cross, suspended from her neck, which left a visible impression on the skin. On the 5th of July, 1831, an inmate of the penitentiary at Bristol, was engaged at needle-work, when the lightning attracted by a pair of scissors enveloped her in a blaze of light. She was much scorched, and lost the use of one eye.

During a thunder-storm a few years since, the lightning entirely consumed, in one blaze, the cobwebs attached to the interior of one of the warehouses of Messrs. Waterhouse, at Halifax. On the 12th of July last, (1832,) the heath at Chierzac was set on fire by lightning, and the conflagration spread so rapidly that 150 men were employed in clearing away the intervening heath to prevent communication with an adjoining forest. About two leagues from Counstances, on the same day, a violent thunder-storm took place, attended with the precipitation of enormous hailstones, by which a number of birds were killed, and a fisherman on the beach dangerously wounded. The following instance of the effects of lightning, occurred in Shropshire. The meteor entered a room where were two children in bed, who escaped untouched; the bed posts, however, were destroyed, every pane of glass was driven out of the window, though a small looking-glass, suspended to the window frame, escaped entire.

About five years ago the lightning struck the bell-tower of the church at Cheen, near Cleobury, about eleven miles from Bridgnorth; the building was set on fire, and five bells out of six were completely melted, and poured down like molten lead. In a thunder-storm that took place last summer (1831), near Hereford, the thick band of iron used as the support of a wooden railing in an adjoining field, was completely melted between each piece of wood: it will be remembered that the bust of the poet Ariosto was struck with lightning prior to the removal of the tomb to the library at Ferrara, and the crown of iron laurels which surrounded the head of the bust, completely melted.

"—— The lightning rent from Ariosto's bust,
The iron crown of laurel's mimic leaves."*

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* Byron.

In July last year a boy near Leith was paralysed by lightning in his legs and arms, and a gentleman's left arm was paralysed while travelling in his gig in Fifeshire; the converse of this has happened, for the paralysed limb has been restored to its wonted vigour, and sight has even been given to the blind. Two persons at Lime-works near Kilsyth, were *twice* struck by lightning, and became insensible. Three stacks of barley were consumed by lightning, near Sleaford, in August, 1832 : the meteor passed through the roof of a house in the vicinity of Boston, and entering four rooms, damaged the ceiling, set two doors on fire, and finally escaped through a window in one of the lower apartments. A toasting fork hanging in one of the lower rooms, attracted the lightning, and was melted in two, also an egg slice and a pair of steel tongs. In the neighbourhood of Glendriff Hill, a person near a hay rick was carried several yards into the air, but did not sustain any material injury. It is stated in the *Edinburgh Observer* that at Auchtergaven a whirlwind arose, carried up a pigstye, and lodged it on the top of an ash tree ; it also lifted a cart-load of fire wood over a house, into the middle of the town, without deranging it. Two dense electrical clouds, at the same time made their appearance in the sky, and as whirlwinds as well as water-spouts have their origin in electricity, they were no doubt connected with the whirlwind in its proximate source. Sometimes a similar phænomenon has been accomplished by what is termed by electricians the " returning stroke."

During last summer there were several severe thunder-storms in Yorkshire, exclusive of those which have been adverted to. At Hainsworth, near Keighley, the electric fluid struck the house of Mr. John Rhodes, shivered a bed-post, and scorched the face of one of his children. At Harrowgate, three joiners who were at work at the Crown Inn, were struck by lightning, and one of them deprived of speech ; the other two were seriously injured. Clifton, near Halifax, was visited with a most severe storm of thunder and lightning, which struck the house of Mr. Samuel Camm, card-maker, with great force, at both ends of the house, throwing off the slates, breaking the hearth-stone in the chamber below, and stones of great thickness in the wall, forcing the plaister, glass, and pictures from the walls, and breaking the windows. Every room in the house was affected except one.

I copy the following paragraph, descriptive of some remarkable effects of lightning at Horsforth, in June 1831, from the *Leeds Mercury*, an ably conducted newspaper; and the discrimination and prudence of the Editors would have been a sufficient guarantee for its accuracy, had it not awakened considerable interest, and induced me to verify the facts by personal enquiry, and obtain further particulars. " On Monday last, about noon, the village of Horsforth was visited by a tremendous thunder-storm. The house of George Lawson was struck by the electric fluid; a square of glass was broken, and the plastering above the window cracked; in the window were seven plants in pots, and each pot was placed in a white saucer; the electric fluid *drove the saucers from under two of the pots, leaving them in their original situation*, and struck three of the children, all of whom were knocked down and remained extremely sick for some time after. It is remarkable that the eldest child, aged 11 years, was burnt upon her left arm by the lightning, and *an impression exactly corresponding* with the branch of the *Aloysia citro-odora*, one of the plants from under which the saucer had been driven, made upon it. Another little girl, aged three years, was burnt upon the thigh, precisely in the same manner, and upon the left arm, with a representation of the *flower* of the same plant; and the little boy, six years of age, was slightly burnt upon his foot; the other members of the family escaped unhurt. In the house of Joseph Riley, which adjoins that of George Lawson, the electric fluid struck a young woman, 22 years of age, of the name of Sarah Taylor, and burnt a mark upon her left arm corresponding with the *branch of a geranium*, which was placed in the window of that house. The house of Mr. Wm. Keir, cloth manufacturer, sustained injury; the chimney was struck, several slates were torn from the roof, the door was shivered to pieces, and two dishes and a pane of glass were broken in the dairy. At Horsforth Wood Side, the house of Mr. Vesty was struck by the electric fluid, eleven panes of glass were broken, and while Mrs. Vesty and her two sons were at dinner, the plates and dishes were driven from the table, and broke to pieces. On the same day a large oak tree was stripped of all its boughs, and completely peeled of its bark, at Bramley Fall, by lightning."

In addition to the preceding statement, I received the following detail on the subject of the impressions of the *aloysia citro-odora*, and *geranium*. The eldest girl was sitting within half a yard, and the youngest about two yards from the plants. About a dozen leaves of the plant were blasted. It also appears that the clothes worn by the children were dark, one claret-colour, the other blue, and emitted a strong smell of sulphur, though not at all marked. The impression which remained on the skin for two or three days, was quite red, and both the leaf and the flowers were of the same colour on the skin. Oil and lime water were applied to the marks, after which the impression became fainter. The skin of the eldest girl appears to have been removed to the extent of an inch diameter. The effect appeared to penetrate the skin, and the shade of colour was uniform. The young woman marked with the geranium branch, was about a yard distant from it; the mark upon her was first black, then changed to blue, and afterwards became red. I know not that I have ever met with any of the phænomena of lightning more remarkable than this circumstance, and I am not aware that in the present state of electrical science, it can be satisfactorily accounted for. The transfer of ponderable matter in the electric flash seems to be substantiated in Fusinieri's experiments, and in some I made expressly with this view, and have mentioned elsewhere; but the difficulty lies in its impressing a fac simile as by the impress of a seal, of the intervening object it has passed over or pervaded. Here the leaves were blighted, and their form in true proportions pencilled on the skin: this seems a feature in the character of lightning hitherto overlooked and unknown. I remember to have met with the detail of a singular phenomenon apparently allied to the same principles and as difficult of solution, the memorandum I took of the circumstance, I have unfortunately mislaid, but the fact was substantially this:—When a vault was opened in a cemetery, I think in Norfolk, it was discovered that in the roof immediately above one of the coffins, which still retained its original position, a copy or fac simile impression of the coffin plate was observed. Explain the phenomenon as we may, the fact is curious and interesting, and both obviously depend on similar principles. That lightning impresses various forms on the clothes and skin of individuals we have abundant proof, so that the peculiar appearances impressed on the clothes of the workmen engaged in the attempt to rebuild the temple on Mount Moriah need excite no scepticism in any mind, and lightning appears to have been the instrument of justice employed to blast the rash crusade.

But how to solve the phenomena on the assumption of Mr. Millman about gases, and explosions, and what not, I cannot tell, as it seems to me to violate all pretensions to science.

The zig-zag or arrowy form of lightning, the brushes, stars, &c. of electric light, the concentric circles, nebulous images, branched and feathery shapes exhibited on resinous plates by positive and negative electricity, and the singular imprint in the frontispiece plate, all combine to shew that its impression may be modified or moulded into singular and curious forms. When Professor Richman, of St. Petersburgh, fell a victim to his experiments on lightning, and the metallic conductors, &c. were destroyed, it will be remembered that they left the impression of their form and dimensions on the clothes of his friend Sockolow. These so far illustrate the phenomena detailed in the cases at Horsforth, though it but partially explains them. Respecting the nature of this remarkable agent we know nothing, and our knowledge and research have only scrutinized a limited portion of its phenomena as exemplified in its agency.

I have presented these statements of the effects of electricity on lightning, not only as curious in themselves; but, as enabling us to judge of its direction, its laws, and its *modus operandi*, they become useful in assisting to form a proper estimate of relative danger, and the requisite provisions of security and safety. Some individuals have contended, and even appealed to chemical analysis in verification, that all precipitations from the atmosphere, whether in the form of rain, snow, or hail, contain some of the elements of aërolites. Be this as it may, the following analysis of small stones enclosed in hail, which appears to have fallen in the circle of Sterlitamak, in the government of Oneaburg, published in the *Bulletin des Sciences Naturelles*, seems to countenance the opinion, and though neither chromium nor nickel appears to have been found, a fractional proportion may be supposed to have escaped detection. These were composed of 1·00 peroxyde of iron, 7·0 oxyde of manganese, 7·50 sulphate of alumina, 3·75 silica, 7·50 sulphur.

Among the most surprising phenomena of meteorology is confessedly the formation of meteoric stones; that these masses are the instantaneous production of atmospherical electricity from materials floating in the air, there can be, I think, no reasonable doubt; all the difficulties crowd into the scale of opposite opinions. That the agent is quite powerful enough, and fully adequate to this effect, there is ample proof; but as this curious subject is treated at full length elsewhere, I shall now only glance at those enigmatical tubes called *ceraunian scinter*, the production of which has very properly been ascribed to lightning; and on this supposition they have been called "lightning tubes," and also *fulgurites* and *astrophylites*. These remarkable silicious productions were first discovered in the Senner Heath, in the county of Lippe; also, near Konigsberg; at Halle, on the Saale; and latterly near Dibbla, in the country of the Tuaricks, in Africa. Similar hollow tubes have been found at Drigg, on the coast of Cumberland, on the estate of the late Mr. Irton, to whose kindness I was indebted for several very curious specimens. In this case the lightning seems to have struck a bank of loose sand, and penetrated the imperfectly non-conducting material to the depth of about thirty feet, fusing it in its progress, and forming an irregular hollow quadrangular tube, the width of which became narrower as its depth increased, and at about 20 to 30 feet it seems to have encountered in its progress, a small pebble of harnstone porphry, from which it glanced off in different directions, forming as it were a root. The whole of the tube throughout, is lined with a vitreous glaze or enamel. Mr. Irton told me that he had nearly lost his life in his endeavours to obtain an entire tube; having descended for this purpose, the loose sand gave way, and he was almost buried alive. It was with the greatest difficulty he was extricated from his perilous situation. There can be no question now as to these being the effects of lightning, and we believe their instant production has been actually witnessed on the continent. About two years ago the lightning fell on a stack of hay in the vicinity of Montrose, Scotland, and portions of it were found fused into vitreous masses, no doubt resulting from the fusion of the silica, which enters as a chemical constituent into the epidermis of grasses.

CHAP. III.

Conductors of Lightning—Condensation of Moisture by Trees, &c.—Endemic, &c. Phenomena—Paragreles—Personal Security in the Storm—The Oak—Aranea Aeronautica—Identity of Electricity and Magnetism—Geography and Electricity of Colour.

A consideration of the laws which govern electricity and determine the direction of lightning, will enable us to subdue its power and concert measures of safety. A conductor does precisely what Mr. Barlow's correcting plate effects on shipboard in reference to the local attraction of the vessel. The following seem to me to be the necessary conditions which ensure the free efficiency of, and constitute a good conductor of, lightning:—Its reception must be facilitated by a fine point, and when received, there must be a perfect and unbroken continuity to allow an unobstructed transit, with a sufficiently extensive conducting surface adequate to a considerable accumulation of electric matter. To these must be added one of the most perfect conducting media, the extremity of which must be sufficiently extended to commit the meteor to the earth, and sufficiently deep to prevent it doing mischief when it escapes from the conductor. As the security of a conductor is limited in its extent of protection to a radius double the length of the conductor, it follows, that if an extensive building, or a range of buildings, is to be protected, more than one will be required. The conductor should overtop the loftiest spire or pinnacle of the building, and in order to preserve the conducting character of the lightning rod, it should be protected from oxydation. These seem the simple features of a good conductor of lightning; such a one as may safely be confided in, and will afford ample security. Copper is the best conducting material, if we, perhaps, except silver: accordingly I selected this metal, and adopted the requisite means to preserve it from oxydation; and as lightning does not *penetrate to any appreciable depth*, and have provided an extensive conducting surface in my new conductor,* by the employment of a hollow tube, to the interior surface of which the electric meteor finds access by small orifices provided toward the summit of the rod. A reference to the plate will afford, without specific figures as to its parts, a correct idea of my plan for a conductor, and I do not know that any necessary desideratum is wanting in it. This conductor consists of copper gas-piping, in lengths of about ten feet, screwed into sockets; terminating at the summit, in a pyramid, inserted by a joint into the hollow pipe; the lightning therefore finds a ready entrance, not only by the sharp point, but the angles of the pyramid. The pipe immediately beneath this joint is *perforated*, so that the lightning may be diffused *over both surfaces*, internal as well as external, and the facilities of escape to the earth will be further enhanced by the wet that penetrates the tube during the rain which generally falls in the storm. This lightning rod is secured from *oxydation* by ribands of zinc attached at specific distances, which operate on galvanic principles; the conductor thus constructed, enters the earth at a slight angle, and terminates in a stone trough, which will be supplied with sufficient moisture by the pipe. Here it is split in twain, and its ramifications pass over the edge of the tank into the subsoil. Perhaps this conductor is not only the *cheapest* but the *best* ever constructed. The first, because from a hollow pipe being employed, the weight of the copper, and consequently the expence, is materially diminished; and the second, because in these conditions all the principles of security are provided. An extensive and an ample conducting surface is given, and facilities both for its reception and final transfer to the earth fully supplied. Add to these, last not least, in the train of securities, there is no interruption whatever, from beginning to end, in the channel by which it descends from its elevation.

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* A great mass of lightning must be provided for; especially at sea, from the inferior conductibility of water compared with the surface of the earth. In the history of electricity we find it recorded that a building was materially injured to which *sixteen* conducting rods were attached. This superfluous

The following are the dimensions of the one erected under my directions, at Huddersfield, and attached to the new church (St. Paul's) there:—The copper piping used was employed in lengths of ten feet. The piping was half an inch diameter, and the metal half an inch thick: the solid pyramidal rod at top is eighteen

number might well be supposed to have destroyed the homogeneity of the meteor by division, and in all probability these rods were worse than useless, being composed of iron, and much corroded by oxydation.

inches long. The tower and spire from the ground to the summit of the cross, present an altitude of 170 feet. The piping cost 1s. 7d. a yard, and the entire cost did not exceed 3*l.* 10s. It is obvious that by employing gas piping, we can render, from the inferior cost, these conductors more generally available than they could otherwise be. The church thus supplied with the conductor, forms, with the two buildings described in the preceding chapter, an inequilateral triangle, and it is of importance to observe, that these effects of the meteor were just without the precincts of what electricians call the *striking distance.* When this fact is conjoined with the loftiness of the spire, towering to an immense height above the surrounding buildings, it must appear, that it affords the most complete evidence of its entire efficacy as a good conducting-rod—nor is it likely that any lightning-rod has had pronounced in its favour, the guarantee of so severe a proof. I had anticipated as an evidence of the complete safety of this conductor, during the prevalence of storms, or in a highly electrified state of the atmosphere, that the lightning would be seen to flicker on its summit, or a brilliant star to illuminate its tip; accordingly, the lightning has been seen to glance in harmless playfulness in the thunder-storm, over its summit. I am not aware that a similar conductor has ever been proposed by any one; and as far as I know therefore, it is unique. Since the destruction occasioned by the lightning at the White Lion, one of these conductors has been erected there. *Two,* I believe, at the New Infirmary, on the subject of which I was consulted by Dr. Walker, of Huddersfield, and one or more at gentlemen's seats in the vicinity. At this moment, five or six of these lightning conductors are being erected in Yorkshire. On the question of conductors, I have, in another place, treated at some length, and my present limits forbid me from entering into more extended detail. The lightning-rod should be insulated as much as possible, and, if it can be conveniently done, threaded through wedges of baked wood, (the lightning-rods on the Royal Exchange, at Paris, pass through glass rings,) and where wires of attachment are required, an intervening belt of some non-conductor (leather), will be necessary. Dr. King, of South Carolina, says, that lightning-rods should not be smooth, but rough and ragged, that each point may detach its portion of electric fluid, and it is said that the rod upon the " State House" has been altered in this manner. To this view of the question we demur, and our reasons are these.—If the surface of the conductor be rough or bristled with points, the electric cloud will diffuse its conflicting influence over a considerable surface, while the great object should be to preserve its homogeneity unbroken, and direct into one uniform channel, by one conduit and at one point, the electric contents of the accumulated mass: besides all this, the point that presents the greatest altitude will be its first recipient, while such a *chevaux de frize* would tend to scatter in all directions the meteor that ought to be entirely confined to the trunk of the rod: the stem should, therefore, be smooth and rounded. Those at all acquainted with electrical experiments know the tendency of escape manifested by electricity when edges or points are supplied. Besides these considerations, I have found that wherever there has been a crack, or flaw, or abrasion, on the surface, in all such places the violence of lightning has ever been manifested; thus the full body of lightning has passed in a harmless current along a *copper* bell wire, and left no traces of its progress until it encountered an irregularity in the surface, or some fracture or trace of oxydation, and there for the first time has it made a furious onset, melting the wire, and by the hiatus thus produced, acquired an accumulation of strength. From that moment every thing that interposed in its current has become the victim of its fury. The grand object, therefore, should be to preserve the uniformity and homogeneity of the current, unbroken. Once dislocated and distracted there are no bounds to its violence and fury. A lightning-rod should be as rectilinear as possible, *i. e.*, without curves or angles. This fact has not been kept so steadily in view as its importance demands. On the continent of America, lightning is frequent; but where the surface has been cleared of trees, the storm is more rare. There are, I am informed, few or no public erections in the United States unsupplied with conductors, and accidents by lightning are constant, indeed of common occurrence beyond their pale. I have not treated of lightning conductors in reference to ships, as Mr. S. W. Harris, of Plymouth, has occupied that ground, and I do not wish to be considered as " building on another man's foundation." To attach strips of copper to the mast by *metallic nails* fastened into the wood, is of doubtful character. The surface of the copper, without some plan to prevent it, would be subject to corrosion or oxydation, and thus entirely destroy its superficial conducting character. A small rod of zinc or iron attached to it, separated from it, except in a few places by interposed lamina of a non-conducting character, would preserve it, and unless this were done, I should tremble for its security when it passes through the keelstone, in which place it must be particularly exposed to the action of bilge water. I must think his endeavours to prove that conductors do not invite or attract the lightning, a labour of supererogation. The *Hannibal*, of Boston, Captain Low, from Virginia for Liverpool, was struck by lightning on the 22nd April, 1824, in lat. 44, long. 40° 30', by which three men were killed, and two died subsequently from bruises. The ship was set on fire and abandoned, after ineffectual attempts to extinguish the flames. Two flashes seem to have successively struck the ship: in the second of these, according to Captain Low's observation, a flame of fire appeared to descend the foremast as great as if a chaldron of burning coals had been thrown from the top of the mast. The following, which displays some of the remarkable phænomena of lightning, is an extract from a communication to Sir Pulteney Malcolm:—

" H. M. S. *Southampton*, Downs, 6th November, 1832.—In a squall at one P. M. yesterday, we were struck with lightning, the electric matter first taking the heel of the mizen top-gallant mast (which was housed), setting fire to the paunch-mat on the mizen top-sail yard, then running down the mizen mast until checked by the sheet of copper in wake of the boom, which partially dispersed it, took a considerable piece out of the mizen mast, seriously injuring Stephen Elgar and John Gibson, yeomen of the signals. Starting the oak planks and copper bolts about the wheel, it got on the main deck and there took a copper bell pull at the cabin door, which conducted it through ten of the quarter deck beams, four of which are a good deal shook, and all the lining of the skylight, mast, and other joiner's work, in its course, torn down. The stream of electric matter appears to have divided when it took the bell pull, part of it running across the deck, shivering a box of grape shot to atoms, and, singular to say, put a 24-pounder shot in a state of partial fusion; it descended to the gun-room by a bolt in the water-way, on the larboard side, and then got hold of the gun-room bell-pull, which carried it over to a cabin on the opposite side, where it exploded, shivering to pieces all the shelves, boxes, &c. In my cabin the explosion was like that of a large quantity of gunpowder: the after-part of the ship was so filled with smoke that at first I was under some apprehension the ship was on fire, and took precautions accordingly."

In the dock-yard at Woolwich, is part of the mast of a ship of war, where the cleet was struck by lightning, and driven downwards, the nails or fastenings grooving the surface of the mast, and entering between the mast and the iron hoop, the latter was moulded to its form. Vessels, therefore, are struck with lightning, though they are unsupplied with lightning-rods; and to infer that the storm-cloud could be attracted from afar by a metallic point, or arrested in its progress, and forced to empty its contents on its summit, without any previous tendency in the cloud to descend, and pour down its electric store, would be absurd. The topic assumes very much of the complexion of the question once stoutly contested, as to the preference that ought to be given to balls or points. I cannot help thinking that two conductors on the plan now recommended, might not only be made effective in preserving the ship from lightning; but, indicating the approach of a storm, might warn the mariner to prepare for its advent. An electric light playing about the top of the conductor would be a better indication of the tempest than the sudden fall of the barometer, or the phænomenon of the sympiesometer; and though this gleam could not be observed by *day*, a set of Canton's bells might be added, and an electric peal announced by them: the storm "casting its shadow" before "the coming event." Such an arrangement finds its counterpart in that of the castle of the Duino, on the Adriatic. Canton's bells are sometimes suspended over the gateway, in particular residences on the Continent. Dr. Franklin's house at Philadelphia was supplied with a metallic rod, extending nine feet above the chimney top. To this rod was connected a wire about the diameter of a goose-quill, which descended through the wall of the stair-case; where an interruption was made, so that the ends of the wire, to each of which a little bell was fixed, were distant from each other about six inches; an insulated brass ball hanging between the two bells. Such was the apparatus, which gave the Doctor ample notice of the storm, and sometimes in sufficiently emphatic peals. It would be advisable, I should conceive, to have this apparatus apart from the conductors, with two of which at least large ships ought to be supplied. The *Quorra*, iron built vessel, employed in Messrs. Landers' expedition into the interior of Africa, as appears by a recent communication, dated off that coast, completely resists the effects of lightning, which seems harmless when it falls on it, though productive of mischief in the others. This doubtless results from the extensive conducting surface exposed to the meteor, and its consequent attenuation from its distribution and diffusion. Thus iron bridges, metallic hothouses, iron forges, and stores, &c. escape, and perhaps steam vessels.

We had elsewhere recorded a remarkable phænomenon,* namely, the condensation of moisture suspended in the atmosphere, by a tall Lombardy poplar. On this the editor of the "Gentleman's Magazine" is pleased to sport a little scepticism, under the impression that I had not sufficiently restrained my fancy in its description. I have only to say, that I gave in simple terms, the facts of the phænomenon. When I describe physical truths, fancy shall have no share in the case. My statement shall ever be "the words of truth and soberness." There are on record notable facts of a similar kind, and why should it be deemed incredible in this particular instance. Not to mention the "raining tree" of one of the Canary Islands,—the *spartium nubigenum*, which, perhaps, is not a solitary example (were vegetation sufficiently investigated in its recesses,) though certainly remarkable; the amiable philosopher of Selborne has described phænomena somewhat similar. I have on the table before me, a communication by a clergyman in confirmation of the fact. Soon after leaving Cheltenham, on the 26th March, 1830, a fall of dense fog came on. The fog settled on the hats, coats, &c. like long white fur. This continued nearly an hour. The fog then disappeared and the sun shone out. The weather through the month of March had been fine, without rain. The roads were perfectly dry where there were no trees by the road side. In a short time I observed a wet place extending in a semi-circular form over half the road. The degree of wet was equal to what a water cart produces. Water *ran from the place several yards* along the dusty part of the road. The coachman said "*a spring had broken out*," but there never had been one there before, and it was curious it should appear in such weather. A similar wet place again occurred; as a *tree* was immediately opposite to this as well as in the former place, it appeared certain that the tree caused the wetness. This was soon confirmed, for trees now frequently occurred by the road side, and opposite each was a wet place, larger or smaller, more or less wet, according to the size of the tree. I have considered that electricity is concerned in these singular phænomena, an inference which I apprehend can easily be substantiated.

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* Atmospherical Electricity, 2nd edition, London, 1830, p. 60.

I have received the description of an electrical phænomenon attended with a sudden and extraordinary deposition of moisture, for which communication I am indebted to Dr. James Kerr, of Paisley. On Monday, 23rd June, 1817, at four p. m., the thermometer stood at 77°, Fahrenheit. The weather had been previously dry, when the pavement and walls became suddenly damp, water trickled from the latter, and carpenter's iron tools, such as saws, &c. suspended against the walls, were completely wet. There was bright sunshine, and the sky almost cloudless. The temperature fell 10°. On referring to the *Glasgow Chronicle* for 28th June and 1st July, 1817, and the *Inverness Journal,* we observe some interesting facts connected with this phænomenon, which seems to have been general. Among the rest we find that vegetation had progressed with unusual rapidity. "Several of the stalks of grain which were measured in fields adjacent to Perth have grown an inch daily." "On Sunday and Monday the quantity of moisture which existed in the air was such as only occurs in tropical climates, and had it not been for the quiescent state of the atmosphere and the great elevation of temperature, (85° in the shade) it must have been attended with copious and extensive rains." The attenuated intensity of colour in flowers is also mentioned, and the wild rose and violet cited as examples. It is added, as the consequence of this elevated temperature and moisture, that "the fine wheat crops in the vicinity of Glasgow are getting into ear, and the field potatoes in many places already overshadow half the ground." Proof demonstrative, if indeed any scepticism could be reasonably entertained about it, that the growth of vegetation is accelerated by electricity. The

Inverness Journal mentions a violent thunder-storm which lasted about three-quarters of an hour, followed by showers of warm and heavy rain. The weather had been sultry, and the crops, though previously unpromising, had recovered and become remarkably healthy and vigorous. On the day following the thunder-storm, two smart shocks of an earthquake were felt in Inverness and its vicinity, and in some houses the bells were rung. I have in another place adverted to the connection of vegetation with some peculiar exhibitions of electricity. An electric light, or gleam, has been seen to play over the corolla of some flowers, a phænomenon said to have been first observed on the blossom of the nasturtium *(tropeolum majus)* by the daughter of Linnæus. A similar appearance has been noticed on the tuberose and marigold, and on the blossom of the oriental poppy. The poppy is described by the observer, Mr. Green, as having been in full bloom, and overtopping the other flowers of the parterre. It is called a beautiful " luminosity" over the corolla of the plant, and is stated to have been observed for three successive evenings, and at intervals of about ten minutes, "sometimes like a large butterfly encircling the whole of the corolla, sometimes at the points of the petals." This was about eight o'clock, p. m. and it is added that " the atmosphere appeared to be in a very humid and electrical state; *drops of water were deposited*, and the pollen very much scattered within the corolla." To doubt the phænomenon being electrical would be pressing scepticism to its utmost limit. Mr. Haggern observed these electrical flashes on the flowers of the following plants in the months of July and August :—The marigold, orange lily, monkshood, and Indian pink.

It will appear from these premises, that it is reasonable to suppose, since luxuriance of vegetation may be fairly ascribed to the electrical condition of the atmosphere, the soil and its rocky substratum, or their respective relations; so, by reversing these principles, sterility and desolation would follow, not estimating the influence of mephitic exhalations which must, however, be duly considered. It is remarkable that since the great earthquake of 1687 no wheat will grow on the coast of Peru. A little is raised, it is true, in some places, but it is unproductive. Before the earthquake a grain of wheat yielded two hundred fold. Rice on the other hand yields a good return. Near Bolton, in Craven, Yorkshire, there is a vale which seems to receive the frequent visitations of lightning. Some cause must exist for these frequent visits, and except in the relative electric character of the subjacent strata, I confess myself unable to account for the phænomenon which it presents. It is called, not inappositely, "The Valley of Desolation." A rapid stream, with frequent waterfalls, flows through the middle of the valley. This valley is about 500 feet above the river *Wharf*, into which it discharges its waters. The valley is clothed with short grass, such as sheep thrive on, and is about 1200 feet above the sea. The whole presents a very desolate scene, from the trees being scathed by lightning. In some trees the trunks are stripped of their bark, and others are levelled with the ground. Every fourth tree is blasted, and only one in eight has entirely escaped. No verdure is found on the blasted spots, but on the other parts of the surface the vegetation, in summer, is luxuriant. I had made some remarks on *malaria* as aggravated by endemic circumstances, and in reference to paragrêles. I am indebted to the intelligent editor of the *Atlas* newspaper for pointing out in connection with my remarks, a fact which had entirely escaped me, namely, that sheep in the Cheviot district are subject to a particular disease, and that it is removed by changing the locality of pasturage.* Without at all justly meriting the impeachment of attaching undue consequence to electricity, or embracing it as an idol of the fancy, it must be granted that its power pervades, and its influence is felt throughout the phænomena of the universe. That *cholera* for instance, is epidemic, or at least, that the atmosphere has a tendency so to operate on the human constitution as to produce in it a morbid change, predisposing the animal system to such an attack, will scarce be doubted, notwithstanding the conflicting opinions which have prevailed on this mysterious subject. Judging from my own feelings in a locality where cholera has prevailed to a considerable degree, I can have no doubt of it, and if any doubt did exist in my mind on the subject; the decided change was too palpable to be for a moment misunderstood. It is remarkable that the aeronautic spider during cholera was seldom seen, and incapable of effecting its aërial excursion, but as soon as cholera abated, the spider assumed its wonted character, and for the first time the feathery configurations made their appearance on the pavement. I exposed a portion of fresh raw muscle to the atmosphere, when it became distinctly acid in the course of 10 hours, as determined by blue litmus paper. Though not the advocate of animate contagion, I was much surprised at the rapidity with which distilled water became charged with animal matter; which, though invisible to the eye, was detected by nitrate of silver—a test pointed out by Dr. John Davy, and which I had employed with success in the analysis of the waters of the Neva and the Ganges. The occasional sensation in the mouth of a metallic taste, was not the least remarkable among the phænomena manifested, which I, in common with others, experienced more than once. The taste was precisely that felt when a slip of silver and one of zinc are brought together over the tongue.

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* "It is a remarkable fact, perhaps, in connexion with this acute suspicion, that in the Cheviot district, sheep are liable to a particular disease locally called *pine;* the complaint is to be overcome only by removing the sheep from the syenitic porphry of the Cheviot mountains to the lime and sandstone sub-strata of the adjoining district."—*Atlas.*

It is by no means my intention to enter in this place on the subject of paragrêles, which are miniature electric rods, having discussed them at some length in my "Treatise." These are founded on the presumption that violent rains and excessive hail-storms have an electric source, and depend for their foundation and accumulation on the principles and laws of electricity; and should any doubt exist as to their efficiency and claim, the facts should be thoroughly sifted and examined. The distance apart of the paragrêles, their height, and the space covered with them, are circumstances it is essentially necessary to know, before any judgment can be pronounced as to their efficiency or non-efficiency: with me, at least, there can be no ground of suspicion.

In this country, indeed, we are happily secure from such terrible floods and hail-storms as waste and desolate the crops in some districts of the continent; still, however, the loss sustained even here, is sometimes considerable. A thunder-storm of last season appears to have embraced a great part of Norfolk. On the 12th of July, at Framlingham, it seems to have been accompanied by a tremendous shower of hail, mingled with fragments of ice. Some of the hailstones were three inches in circumference. Mrs. Rigby suffered severely in her greenhouse, where 1400 panes of glass were destroyed, and great injury sustained among the exotics. In the garden, apples, gooseberries, &c. were torn to pieces, and scattered on the ground. On the 8th of July, last year, the entire harvest in the Commune of Epinal was destroyed by the rain-floods, and the loss estimated at 400,000 francs: indeed the *annual average* of damage by hail at the foot of Mont d'Or, is calculated at from 8 to 10,000 francs. In 1826, the Agricultural Society of Lyons placed 400 paragrêles on the highest elevations of Mont d'Or, in an extent of about six miles, as all the storm-clouds which shower down hail on the fertile lands, lying along its base, pass over it. These vineyards and cornfields we believe have been remarkably protected. The entire expence of the erection of these 400 paragrêles did not exceed 1500 to 1600 francs, or about 3s. 3d. to 3s. 4d. each, and they will last five years.

I had suggested an interesting experiment, namely, the interspersion of paragrêles among the *hop grounds*, and given what I considered sufficient reasons for the adoption of this measure by the hop grower. Mr. James Rennie, in his usual officious manner, chose without the slightest ground for his uncalled-for attack, to question the propriety of that suggestion, though I believe that my reply has been completely successful.—As to the *cost*, a string which he touches among the rest, let the expence of those erected on Mont d'Or supply the answer, and as *hop poles must be supplied at any rate* to support the hop bine, the expence of converting a hop pole here and there into a paragrêle, would not exceed *eighteen-pence* each. There is still another important consideration hingeing on this question. Such an arrangement might promote the luxuriance, and of course the health and produce of the hop crop, independant of the entire security which the hop grounds would receive from the visitations of the storm. A severe thunder-storm, accompanied with hail might, in a few minutes, utterly destroy the entire crop for the year. Can a guarantee against such an event be then a trifle? I have already adverted to the remarkable luxuriance and rapid growth of the crops during the prevalence of thunder-storms in Scotland, in 1817. The attachment of globules of dew to the pointed tips of leaves and spines of plants, seems to owe its origin to electric influence, and if any corroboration of the correctness of my views were wanted, it would be found in the following facts:—When electrical conductors of iron were placed among the branches of a fruit tree in the orchard, that tree produced a greater crop of fruit than any other. Brunodi Sazzi found that a branch of the gleditschia triacanthos, two feet long, with one spine, attracted as much electricity as a single brass point. This plant is of rapid growth. Amoreti sowed turnip seed in two pots, one was electrified, and in fifteen days electrified again. In three weeks the plants which had been electrified were four inches higher than those in the other pot.

A proper attention to the question of conductors and non-conductors of electricity will guide us in the proper means to secure our personal safety. When in the house it will be found necessary to avoid all contact with conducting materials, particularly those of a metallic character. Some have foolishly taken refuge in the cellar, under the impression that it was their best security. A medical gentleman, who accidentally entered his cellar during a thunder-storm, informed me he had received a violent shock; and two or three years ago a person was killed by lightning in a cellar in Yorkshire. Perhaps the best part of a house is the first floor and the centre of a room. For obvious reasons it is well to avoid gilded mouldings, mirrors, pictures, &c., also the fire-place, supplied as it is with conducting materials in the carbonaceous matter that lines the chimney, not to mention the grate and fire-irons. Reclining in as horizontal a position as possible on a sofa, will be favourable to personal security. A patent has, however, unfortunately for our views, been taken out, we believe, for beds, chairs, sofas, &c. being stuffed with wire! In a thunder-storm such would, we think, be perilous in a high degree, and to sit on them were as dangerous as to be placed on a barrel of gunpowder with the match applied. I am no enemy to useful improvement and discovery; let mental ingenuity have its full swing; but when the introduction of any novelty, viewed on scientific principles, interferes with individual or public safety, I shall feel it my duty, should it fall into my train of research, to unfold my sentiments honestly on the subject, and leave the public to judge for themselves. Unquestionably the bed, almost entirely insulated, as it usually is, and surrounded as the individual placed on it is, by non-conducting substances, must offer a safe situation. I have, indeed, heard of cases where individuals under such circumstances have been injured, and even killed; but these instances are extremely rare, and altogether equivocal. Some peculiarities in the case have contributed to an exception, which is altogether extraordinary: on the other hand there are numerous examples of the almost entire furniture in the room having been injured or destroyed, including the bed-posts, and yet the person in bed has escaped entirely. Even the plates on the side board, the knives and forks, and spoons on the table, may determine the direction of the lightning, and every thing metallic about the person had better for a time be laid aside. By referring to some of the examples cited, it will be seen that a tombac cross, a pair of scissors, a knitting needle, (I have elsewhere mentioned the silver key of a flute), &c., have been circumstances determining the course of the meteor; even the watch and money in the pocket may bias the direction of the lightning. It is scarcely possible to be placed in circumstances to avail ourselves of all these means of security; but where it can conveniently be done, we should certainly consider our safety best warranted by adopting them.

I remember on one occasion to have been engaged making electrical experiments; and, during these researches, had been for some time insulated and connected with the prime conductor of the electrical machine when in action. Soon afterwards I had applied both hands to my watch to ascertain the hour, when I received a smart electrical shock. It is probable that one of the surfaces of the watch-glass, and perhaps the lower surface of the dial had received the electric charge,—the discharge is easily accounted for. It is deemed altogether superfluous to be specific on the several circumstances which may occur to different individuals, as attention to their relation to conductors and non-conductors will determine the most prudent measures.

When out of doors we should avoid elevated situations, and taking shelter under a wall; or walking along canals, pools, ponds, or rivers; because water, which is an imperfect conductor, will determine the fall of the lightning; while the upright human form and the animal fluids afford a more ready escape to the ground. If rain falls during the storm, and the clothes are wet, we shall find our safety in this circumstance. It is nothing short of madness to use an umbrella in a thunder-storm, since it will present an attractive focus ; and while wet clothes may render the lightning harmless, the opposite effect will be produced by the imperfect conducting character of the dress. Thus persons have been killed on the coach top during a thunder-storm, when they sought the shelter of an umbrella, while the other passengers have escaped. Mr. D., of Wakefield, informed me that he has seen the lightning strike an umbrella, which had been held up by a person on the carriage box, during a storm;—it was shivered to pieces, and the individual hurled to the ground. The folly of ringing bells during a thunder-storm cannot be too severely reprobated, as it not only perpetuates superstition, but puts the ringers in jeopardy. The number of lives lost under such circumstances at Carcasonne, in France, ought to be a sufficient warning. The spirit of the storm is not to be thus subdued. The Celtic Deity, Bera, was supposed to preside over the thunder-storm. Tempests rose, and the debacle rushed from the rock at her command. Her abode was on the loftiest hills, and Bera could leap with ease from mountain to mountain. Such was the personification with which a Gothic Mythology clothed the mysteries of the storm-cloud ; but these superstitions belong not to the present day of intellectual endowment. Lord Bacon observes, "it is believed by some that great ringing of bells in populous cities hath chaced away thunder, and also dissipated pestilential air." "Bells," says Fuller, "are no sufficient charm against lightning. The frequent firing of abbey churches by lightning confuteth the proud motto commonly written on bells." "It appears that abbey churches, though quilted with bells almost cap-a-pee, were not proof against the sword of God's vengeance. Yea, generally when the heavens in tempests did strike fire, the steeples of abbeys proved often their timber, whose frequent burnings portended their final destruction." Should the flash be succeeded by the sound,* without any sensible interval, we should cast ourselves on the ground, and maintain a horizontal position ; but what is of most importance to be attended to, is on *no account to take shelter under a tree*, especially if that tree be insulated; above all, if it should happen to be an *oak*, other trees are occasionally struck, but in at least eleven cases out of twelve, *oaks* are the victims. It would be extremely difficult to determine the reason for this preference; but the fact is notorious. It has been suggested to me that it may perhaps be found in the great depth to which the *tap root* of the oak penetrates the ground. The idea seems plausible, and the contorted and convoluted structure of the tree may account for the ruin which it suffers when the lightning falls on it. I have already described the remarkable destruction of the oak at the seat of Sir Foster Cunliffe, Baronet, near Wrexham. I got a drawing made* some time afterwards of the oak struck by lightning on 28th June, 1813, which stood on a farm then occupied by Wm. Warters, on the estate of the late Sir Wm. Smyth, Baronet, in the parish of Stapleford Tawney, Essex. This tree stood in the middle of a field detached from all other trees. The *bole*, or main trunk of the tree, was reduced to a complete mass of *fibres*, but the branches were not injured. The tree fell on the ground, and part of the trunk was scattered in every direction. Some of the pieces were projected to the distance of more than 100 yards; and one piece, weighing more than half a cwt., was carried upwards of 60 yards. In Mr. Loudon's very interesting *Magazine of Natural History* for July, 1821, No. viii., p. 230, is a curious notice relative to two oaks. One of these, in the parish of Weston, Norfolk, was struck by lightning, 26th September, 1828. Not the slightest particle of bark was left upon the trunk, although not a bough was affected in that way, nor the leaves thrown off,—pieces of bark were projected to the distance of 90 yards. This oak seems to have been one of six trees growing in a line and not the tallest. In the summer of 1822 a fine oak was struck; it, however, continued to grow, and even to flourish, till 1828, when it was felled, and proved to be "sound in most parts." The following is the most singular part of the history connected with it.—"The tree was large and wide-spreading, affording shade in the summer and shelter in the winter, to the stock turned out to pasture; and, at times, attracted attention from the number it could cover. From the time *of its being struck, not a head of cattle has been near it*, not only not seeking its shade, but *obviously avoiding the tree* as being disagreeable."

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* The velocity of electricity is incomparably greater than that of sound.

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* By Wm. Franklin, a *shoemaker*, who made an exquisite sketch of it with pen and ink, scarcely distinguishable from a superior print. This person subsequently received the silver Isis medal from the Society of Arts for a similar drawing. He is now in London, and succeeds as *an engraver*.

By the kindness of Mr. T. Squire, of Epping, who drew up a very interesting detail of the Toot Hill windmill, destroyed by lightning, in June, 1827, an account of which I have given in my "Treatise on Atmospherical Electricity," I am favoured, among others, with the following, which I select from the number. The first is interesting, as referring to a poplar in the town of Epping. "On the 30th of July, 1827, at 4h. 7m. a. m., a poplar attracted the lightning, which entered about a third way down from the top, where it tore off the bark, as well as near the bottom. The electric fluid did not enter the ground near the root of the tree, which was very dry and dusty, but passed through the leaves of some pompions growing there, from them it *rose* to the hook of a gate, and passing along the upper rail by the wing of the thimble, it was conducted through the rail by some nails to the latch; it then passed down the post, which it split, to the ground."

"On the 27th of April, 1821, between the hours of three and four o'clock, a. m., an oak was struck by lightning not far from Potter's-street, on the London-road. It was a pollard, and stood in a field near a wood. The head *was completely struck off*, and split into several pieces; some of which were thrown 70 or 80 yards, and one piece, as much as two men could carry, was hurled to a great distance."

"On the 28th of May, 1821, about three, a. m. a storm rose suddenly from W. N. W., and produced several sharp snapping claps of thunder. Three oaks in one neighbourhood were struck during this storm; they were nearly in a line with the direction of the storm. Those at each end were about two miles apart, and the other nearly mid-way between them. The one to the west was struck in the head, and very much shattered; the next received the lightning at one of the lateral branches. The electric fluid passed along the upper side of this branch for a considerable way, then the under side, and finally down the trunk to the ground, making a groove in the wood, as if a plane had passed down it, throwing the bark off on each side, about six or eight inches; the tree was not otherwise injured. The third tree was struck by one of the side branches, and the bark torn off the trunk from top to bottom, on the north side, but the wood was not injured."

These additional examples are cited and referred to, to prove how dangerous it is to seek shelter during a storm under *trees*, especially the OAK. It seems essential to do so, as the error in question is as common as it is fatal. The greater part of the accidents which occur proceed from this source.—During last summer a county magistrate was killed by lightning under a tree, whither he had gone for shelter. These facts will also shew how dangerous it is to plant the *oak* on lawns, &c. near gentlemen's seats.

I have elsewhere described the ascent of the spider into the atmosphere to electricity, and the conjoined opinions of the Editors of the *Eclectic Review*, *Magazine of Natural History*,* *Atlas*, &c., seem to give me the merit of having established my point. I drew my inferences from *facts*. It never entered my head to suppose the principle of ascent to be electrical, and then search for facts to support it, or make phænomena bend to preconceived fancies; on the contrary, my conclusions were the result of research. In Lowthrop's Abridgment of the Trans. of the Royal Society, vol. 11, p. 794, we have the following remarks on the ascent of the spider. " Attending to one that wrought a net, I saw it,'' says a nice observer, " suddenly in the mid-work, desist, and turn his tail into the wind, to dart out a thread with the violence we see water spout out of a spring: this thread taken up by the wind was in a moment *emitted some fathoms long*, still issuing out of his belly. By and by the spider leapt into the air, and the thread mounted her up swiftly, and I found the air filled with old and young sailing on their threads, and undoubtedly, says the relater, *seizing gnats and other insects in their passage*, there being often manifest signs of slaughter, as legs and wings of flies, on their lines as on their webs below.'' It is added that this ''darting'' takes place from the top of a " brand.'' " After the first flight, all the time of their sailing, on those threads they make locks, still darting forth fresh supplies of thread to sport and sail by.'' Dr. Hull says he has seen them shoot their webs *three yards long* before they begin to sail on them; and Derham says he has also seen them dart their threads, and sail away by means of them. In the summer of 1828, an observer, in a communication to the *Philosophical Magazine*, says, he made a number of experiments on the lake of Thun, on spiders, is confident they can project their threads 25 to 30 or more yards long, and states one case where the extent was 20 yards,—the thread fastening to a tree at that distance from the spot on the lake. The line was drawn tight by the thread being coiled up, and this coil swallowed by the spider, was fastened, and formed a line of communication. To what I have elsewhere advanced on the question of the means by which this extraordinary aërial navigation is accomplished, it would be a superfluous task to make additions. It may be curious, however, to analyze the memoir of M. Virey, of France, as extracted from the Bulletin des Sciences Naturelles,* as communicated to the Royal Institute of France, June, 1821. The author states that these gossamer threads make their appearance in autumn, before the frosts set in,—white filaments are seen to traverse the air at different altitudes, and these are called in France, "fils de la vierge." Blanched webs become white, like linen webs, by the prolonged action of air and moisture. These threads carry up with them little springing spiders, as observed by the German Naturalists, Starck, Buhlman, Flugg, &c., and particularly by Gravenhurst, who has described them under the name of *Aranea Obstetrix.* The phænomena of ascent, our author observes, have been explained in various ways; as by the influence of evaporation, electricity, and ascending currents, as advocated by Mr. John Blackwall. Respecting the last, M. Virey has the following observation :—" M. Blackwall n'a pas donné, selon nous une explication satisfaisante du phenomene de l'ascension aëronautique de ces filamens." As to aërial ascent, M. Virey attributes the original idea connected with this to Gravenhurst, referring to an article in one of the German scientific journals for 1823, who first explained these ascensions, (filamens de la Vierge,) by observing that the wind raises the webs, (previously suspended to the branches of trees) along with the spiders entangled in the meshes, throwing their threads in every direction, *ludibria ventis.*

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* " From the many proofs brought forward by Mr. Murray and his friends, there seems to be no longer any doubt of the fact;" as to these charioteers or aeronauts being carried aloft by electricity, and in reference to Mr. Blackwall's " currents," it is added, " it is questionable whether they are at all times so powerful as to cause the ascent of any particle of matter, even so light as an aeronautic spider."

Rejecting the opinions of others, M. Virey proceeds to propound his own, having acquired, according to his peculiar notions,

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* Paris, 1831., p. 130.

proof of the spontaneous ascent of minute spiders, (the larger ones exhibiting the phænomenon with more difficulty), as deduced from experiments made in a close room, and consequently without the intervention of winds or currents to aid their ascent. Our author, in despite of former views and theories, comes to the conclusion, that these spiders were only borne into the air, in the first instance, like the *elaters*, by a spring, and afterwards their feet served them for sails and oars, or the balloon and its tackling. His own words are—" nous croyons voir en eux seulement de très habiles voltigeurs,"—then follows an allusion to that particular spider called the " jumping spider," who performs his " sauts brusques" without any thread whatever; and certainly if this spider could ascend into, and sail in the air, there might be some faint pretext for the idea, but, unfortunately for this odd notion, it *cannot;* and M. Virey might as well have singled out the jerboa, or the Canadian jumping mouse, as the elater, or the jumping spider. To observe M. Virey's wonders, we are directed to take the *young* of the *epeira diadema,* common enough in spring. These said young are to be held in one hand, and their fall prevented with the other. The hand is passed round to see that no thread is propelled, &c.—the spider will then let itself down, and will rise (with *sauts brusques?*) from the perpendicular, sometimes horizontal, at other times more or less oblique. He especially directs these experiments to be made in the still air of a room—" dans une chambre close, ou l'air tres calme ne puisse recevoir aucune agitation." All this so far, (thus diametrically opposed to Messrs. Blackwall and Rennie) is merely a repetition of experiments I had many years before published in the " Memoirs" of the Wernerian Society.

" Les plus grasses boudisent," says M. Virey, " par un élan si rapide qu'n á pas le tems de bien examiner comment elles disparaissent." After this confession, it is too much to tax our credulity by demanding our assent to unsupported fancies. However, our author, in reflecting on the extraordinary phænomenon of the floatage of these spiders, in defiance of the laws of gravitation, came to the following as the only satisfactory conclusion at which he could arrive. That somehow or other the insect by means of its eight limbs was enabled to *swim through the air*, but lest I should be supposed to attach an unwarrantable inference, I give his own words, "à l'aide des huit pattes que l'animal peut faire vibrer avèc agilite, *il nage dans l'air.*" This vibration he compares to that of wings, as in dipterous insects and birds. This marvellous gift of *flying limbs* is certainly a new discovery in physics, and had M. Virey's genius been established in an earlier era of the world, the "pattes volantes" might have been appropriately substituted for the wings in the Egyptian Sphinx, the Mé of the Chinese, and the Griffin of the Greeks. Even Mercury and his caduceus might have been plumed with "pattes volantes." Wise in his own conceit, however, he pronounces that every one may prove the matter for himself. I fear, however, that *Tekel* must be written over against every such attempt. Our philosopher think it more probable that these little spiders "volent avec leurs pattes," than that their ascent should be ascribed either to electricity or aërial currents. No doubt these curious things called "pattes volantes" will be duly provided for in the formulæ of the entymologist. M. Virey, however, talks about having demonstrated, by direct experiments, these marvellous announcements, though no such experiments are to be found related in his "Memoire." The following is his conclusion:—"La Nature modifie danc les organismes selon les functions quèlle leur attribue pour ses desseinis, dans la république de chaque monde." This paper is certainly a curiosity of its kind.

To the common observer the *cui bono* incessantly presents itself, and though we should not reject a particular topic of intellectual pursuit, until its more practically useful adaptation in the economy of life had been discovered, yet even in this, at first sight, trivial research, there seems to be practical usefulness. The violent winds which blow in the West Indies have, as their herald, a peculiar and curious phænomenon, in the appearance of an immense quantity of fine cobwebs in the air, which stream from all parts of a vessel's rigging. While off Zampico they were observed by an intelligent officer on two occasions, and also at Vera Cruz, all of which were followed by those violent tempests called "Northers." That at Vera Cruz came on at sun rise; light and delicate in their flimsy structure, the least wind sweeps these cobwebs away, so that they can only be noticed on a calm sunny day, when the atmosphere is tranquil, and then are seen to wave from all parts of the rigging. The Rio de la Plata is 120 miles wide at its junction with the ocean, and for 150 miles inland not less than from 20 to 30 miles broad. Temple says, that in this river "the rigging of the ship, from top to bottom, was literally covered with long fine cobwebs that had blown off the shore, having attached to them insect manufacturers who dispersed themselves in thousands on our decks." This phænomenon was followed by a storm. Thus they presage the coming storm, and are connected with a falling barometer,—another proof of the connection of the rise and fall of the aërial spider with electricity, and those who doubt that an electric change precedes the hurricane or the tempest, must resign all pretentions to the character of an acquaintance with the science of meteorology.

The following effects of lightning are interesting as connected with the communication of magnetism. On 13th April, 1832, about half-past three o'clock, p. m., after the travelling carriage of Mr. and Mrs. T. T. Bodington, of Badger Hall, had left Tenbury, they were overtaken by a thunder-storm. The lightning struck an old umbrella open at the time. One horse was killed, the postillion unseated and thrown to a distance, and the pole was broken through,—the carriage was not materially injured. The umbrella referred to was shivered to pieces, and Mr. and Mrs. Bodington seriously injured. The flash of lightning to observers seemed to part into four divisions when it came within thirty yards of the ground. Mr. B.'s gold shirt buttons were fused, a knife ejected from his pocket, and every article of dress torn away as if by gunpowder. Two pairs of scissors in Mrs. B.'s work box were found completely *magnetised*, and the balance wheel of Mr. B.'s watch so much so, that it has since been mounted as a compass. From the umbrella the lightning appears to have been attracted to a wire in the bonnet of Mrs. Bodington, and finally to the steel busk, which acquired a permanent polarity. Both ends attracted the south pole of the needle, and at about one third from the bottom attracted the north pole. The busk was fused for about $\frac{1}{4}$ inch on the upper surface, which had a blistered appearance. There were also two other marks.

The identity of the wonderful agent, we have been considering; with *magnetism*, seems now to be fully established; and passing over all the wonders of electro-magnetism and thermo-magnetism with the magnetism of light; it now appears that the electric spark has been actually obtained, both on the continent and in this country, from a powerful magnet. The magnetic bearing and direction of the electric arch and curtain of the aurora borealis have always appeared to me to prove their identity or affinity, and the following phænomenon of a luminous character communicated to the Baron de Zach, seems to be similar. A remarkable light is seen toward the N.E. and S.W., like the zodiacal light, and always observed in the magnetic meridian, appearing more luminous in the N.W. than S.E. This magnetic light may be seen when the sky is partially obscured with clouds. At a very early period of the introduction of electro-magnetism, both Sir Humphry Davy and M. Ampere endeavoured to prove that electricity and magnetism were *identical.* Their proofs failed. I had entertained the same idea from the beginning, and adduced what I considered sufficient evidence, nor have I ever since seen cause to alter that opinion. It was, however, too much for *me,* in Mr. Faraday's estimation, to enter the lists where Ampere and Davy had been foiled. Accordingly he thought proper to attack me *anonymously* in the "Annals of Philosophy," and it is now curious to see him endeavouring to establish that opinion, which he then *vi et armis* strove to impugn and controvert. I may subjoin the detail of a few of the experiments I then made with a view to prove their identity. Some of these I stated in a letter to the late Dr. E. D. Clarke, of Cambridge, who, in a subsequent letter to me, mentioned his having repeated the experiments and shown them to Dr. Ure, informing him at the same time that they were due to me. I found that when a horse shoe magnet was immersed in muriate of baryta and sulphate of silver, the silver was entirely reduced. When a broad magnetic bar was partially plunged into a solution of nitrate of silver for some time, the silver was reduced in brilliant metallic plates of a somewhat crystaline arrangement and geometric form, while above the surface of the solution, the steel bar appeared corroded by the vapour of nitrous acid gas. The metallic silver encrusted the *ends* and *edges* of the bar, and was most copious where the magnetic influence was most powerful. In solution of permuriate of mercury the magnet precipitated around it, in the same way, globules of running mercury, and the reduction was always more or less abundant, corresponding with the magnetic power with which the bar was invested. As the electric spark may be employed as an agent of decomposition, and as that spark has been procured from the magnet, the phænomenon I have described, cannot reasonably be assigned to any other cause than the magnetic fluid,—thus my conclusions are verified. Besides, chemical affinities are identified with electrical action, and there being in this case chemical affinities more or less energetic in proportion to the power of the magnet, it necessarily follows that they *are one and the same*, though its manifestation in magnetism be a curious feature of its protean character. The decomposition of water, it is stated, has been effected by the electricity of the magnet, and though Mr. Faraday seems reluctant to admit it, I am at a loss to discover on what grounds that slow assent is founded. The electricity which is produced, whether by friction in the electrical machine, or by acids in the galvanic circle, is an agent to which chemical composition, or decomposition as may be, is subordinated, and it is natural to presume that electricity produced from other sources, whether from light or the magnet, should do the same.

I have been long persuaded that colours are possessed of an electric character more or less intense, regularly increasing or decreasing agreeable to their position on the chromatic scale, and finding the measure of that intensity expressed in the *degree of temperature possessed by each*, which I have found holds good not only in the colours of the prism, or light so decomposed, but in the colours that decorate creation, whether in the animal or vegetable kingdom. A system of decomposition then is always going on in the sunbeams, whether in the gay corolla of the flower or the green attire of the foliage ; and, were this the place, I could describe a series of experiments made with this view, which would go far to demonstrate the position for which I contend. I have ever contemplated a geographical distribution of colour on the surface of the globe, and in THAT GEOGRAPHY OF COLOUR perceive that my views are substantially correct. Local circumstances may interfere, partially, to modify this law, but viewed on the great scale of generalization, it will be found to hold good. In lower latitudes we meet with the scarlet ibis, and other kindred birds, while the flamingo gleams among the lagoons of the new world. In these regions are found the *amhertia nobilis, bom-*

byx speciosa, the *lobelia cardinalis* and *fulgens*, *saliva splendens*, *lychnis calcedonica*, and *verbena melindris*, clothed in equally dazzling attire. In temperate climes, the prevailing hue will be found towards the middle of the chromatic scale. In Britain, for instance, the yellow *ranunculus acris* enamels our fields, and the marsh-mallow, &c. spring up by the verge of the pool. Primroses and cowslips mingle in the woods—appear in the hedge row, or clothe the meadow. Just so is it with flowers that sport less gaudy liveries. Blue and white will be more predominant as we advance to the arctic and antarctic circles. It requires no argument to prove that this corresponds with the distribution of the relative intensity of the magnetic force on the terrestrial surface.

FINIS.

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